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ADDRESS AT THE DEDICATION OF THE MITCHELL MEMORIAL BUILDING OF THE PHILADELPHIA ORTHOPÆDIC HOSPITAL AND INFIRMARY FOR NERVOUS DISEASES[1]

OBSERVE the title of the building we are assembled to dedicate—the Mitchell Memorial Building of the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. It is not the *S. Weir* Mitchell or the *Weir* Mitchell Memorial, but simply the "*Mitchell* Memorial" Building.[2] As there are many Franklins but only one Franklin, so there are many Mitchells but only one Mitchell.

I first saw Weir Mitchell on the third of September, 1860, just as I was beginning the arduous study which has filled a long life time. The last time I saw him was at Christmas time in 1913, just before the shadow of death fell upon him. The interval covered fifty-three years and four months—a long time for an intimate friendship which never knew a cloud even as big as a man's hand.

He was my senior by only eight years, but, having graduated ten years before I began even to study medicine and having already an established reputation, I always looked up to him as my father in the profession rather than as an elder brother.

I first aided him in his experiments on the poison of snakes—a study which for almost half a century fascinated him and to which he, first alone, and later with

[1] By Dr. W. W. Keen, consulting surgeon to the hospital.

[2] This was the name then on the new building. Later it was replaced by the "Silas Weir Mitchell Memorial."

Reichert and Noguchi, made most valuable contributions.

During these experiments one incident was an excellent illustration of the mental alertness which was so striking an element in Mitchell's character. One hot July just after we had collected one or perhaps two teaspoonfuls of the liquid snake-poison in a small cup Mitchell was called out of town for three or four days. Usually we immediately spread out this liquid in a thin layer so that it would dry quickly before decomposition set in, but by an oversight on this occasion it was left in the cup in bulk and naturally in such weather underwent quick decomposition. On his return we went to the laboratory and on opening the door were almost knocked down by the horrible stench. Who of us here would not have sought the source of the smell and in all haste have thrown it away. Not so Mitchell. Instantly he turned to me and said, "I wonder if decomposition has destroyed its poisonous character. Let's try it." That was always his desire—to put everything to the test of experiment. A single experiment showed that for a pigeon it was as virulent as ever. How subtle and potent was the poison that even decomposition left intact! But not to every form of life was it even then a poison, for disporting themselves in the cup were a host of nimble little animalculæ having apparently the time of their lives.

Within a half year of our first meeting came on the sterner studies of the Civil War—studies which he again illuminated by his brilliant investigations and in which I again had the great good fortune to be his assistant, especially in the Turner's Lane Army Hospital for Diseases and Injuries of the Nervous System in this city. This was only one of several special army hospitals for which science and the American soldiers were indebted to Mitchell, for it was he who suggested the idea to Surgeon-General Hammond.

In fact I have always felt that my intimate acquaintance with Weir Mitchell was the first of three epochal events in my life. The stimulus and direction of my professional life began in those days with him as the dominant factor. I have always gladly acknowledged this great debt. I have met and known many of the best in medicine and surgery in America and in Europe and I say unhesitatingly that Weir Mitchell was the most original, fertile, stimulating medical man I have ever met either here or abroad.

Early in his professional life a vacancy occurred in the chair of physiology at his alma mater, the Jefferson Medical College, a position for which his studies in anatomy, physiology and toxicology had preeminently fitted him. But the trustees had not the vision, the imagination to discern the genius they might have obtained. A very few years later the University of Pennsylvania trustees also were equally blind and so he never became a "professor."

But years afterward he had the privilege as a trustee of the University of Pennsylvania to elect professors. The fight over his election to the board was one between the conservatives and the progressives and under the leadership of William Pepper, H. C. Wood, Tyson, Harrison Allen, and their valiant friends, Mitchell was elected, and a new University of Pennsylvania Medical School arose.

Calling on him after the election, Allen, by a happy quotation, well described Mitchell's status

Thou shall not be King but thou shalt beget Kings.

What discoveries he would have made, what a school of young experimental physiologists he would have created, had either of those two great schools but appreciated the genius they might have had we can only guess.

But these two, for him, fortunate defeats, and his experiences in the Civil War

decided his career. Thenceforward all his powers, all his energies, were devoted to neurology—then almost a new department of medicine with which we are now so familiar.

His very touch was vibrant with the restless mental forces within him. Every institution with which he was connected, every committee he was on, took on a new and vigorous life. The University of Pennsylvania, the College of Physicians, the Directory for Nurses, the Philadelphia Library, and in later life the Carnegie Institution and this hospital, all felt the throb of his genius.

Another evidence of Dr. Mitchell's wide influence and at the same time a beautiful tribute to his memory, so modestly done that I have only just heard of it, is the fully equipped Convalescent Home for Children established by Miss Anne Thomson near Devon. While other hospitals share in this bounty, Miss Thomson's first thought was for this hospital so dear to Dr. Mitchell's heart and therefore to her own. The same potent influence won for you the services of your invaluable president.

In 1871 his connection with the Orthopædic Hospital began. He had thirsted for several years for the wider circle of clinical opportunities which a hospital would give for the observation of neurological diseases. There was no hospital in Philadelphia which had even so much as a ward for these sorely suffering patients, often indeed derelicts on the sea of humanity. Indeed, there were then but six such hospitals in all Europe and only two others in the United States. Mitchell, with quick vision, recognized his opportunity. Many of the results of nervous diseases, especially of their palsies, resulted in deformities and disabilities which could only be remedied or alleviated by orthopædic surgery.

In 1867 on Ninth Street, between Market and Chestnut Streets, Thomas G. Morton, H. Earnest Goodman, Agnew and the two Grosses had founded a small "Orthopædic Hospital." Mitchell joined forces with them and from this little mustard seed has grown this great tree, whose branches have indeed been for the healing of the nations, for its patients drawn especially by Mitchell's great reputation came not only from all over the United States, but from foreign countries as well.

The name was lengthened in 1893 to "The Orthopædic Hospital and Infirmary for Nervous Diseases." If I may be allowed a linguistic license the tail began by being longer than the dog and it ended by its wagging the dog. As I was formerly on the active and am now on the consulting surgical staff this homely simile is perhaps permissible.

By 1873 their narrow quarters became too strait for the rapidly growing hospital and they removed to Seventeenth and Summer Streets, where an old residence was fitted up. Then the community recognized it. Funds began to be given and bequeathed and patients multiplied. A few years later (1887) a new hospital building on the site of the old residence was opened, Mr. Kuhn being the chairman of the building committee. This in turn was outgrown and successively adjoining lots were purchased until now the hospital owns seven lots with a front of 224 feet on Summer Street and 116 feet on Seventeenth Street, though the last lot (no. 1713), presented to the hospital as a memorial to his father by the liberal and energetic president, C. Hartman Kuhn, Esq., is as yet not physically incorporated into the hospital.

A live growing hospital, like a live growing baby, is always greedy for nourishment, but unlike the baby never suffers from indigestion. There is a hospital physiology which differs from that of animals and humans. Even a gorging Thanksgiving dinner followed by a dessert

up to the bursting point—in the case of the hospital a dessert of thousand-dollar checks —never "upsets" but actually "sets up" both its appetite and its digestion.

The above I give you notice is the most important paragraph in my whole address.

For eight years, from 1890 to 1898 I was so fortunate as to be Mitchell's colleague as one of the three orthopædic surgeons and I can testify, therefore, from my experience, both in the Civil War and in this hospital, to the wonderful stimulating influence which Dr. Mitchell exerted. This was manifested not only in the conduct of the hospital, but in his influence on the medical and surgical staff and especially on his own assistants, on the resident physicians, and on the many doctors who flocked to his weekly clinics and bore away with them an inspiration for good work all over the land.

These bright men of mature years sat at the feet of the master to be taught much that the best of them did not know, to catch glimpses of the guesses of genius which later grew into the certainties of science, to hear and repeat his many picturesque and impressive descriptions or happy or pungent phrases, struck like sparks off the anvil.

But while visiting strangers were welcomed and departed with many a sheaf, it was his regular assistants and the residents in the hospital who were indeed twice blessed. To begin with a new patient; to observe Mitchell's careful cross examination as to the earliest symptoms; his minute following up of even a stray hint which to an ordinary man would have meant little or nothing, but which to Mitchell was a veritable guide post to the right road; to hear him compare or contrast this case with other similar or opposite cases garnered by an accurate memory from the myriad cases seen one year, five years, ten or even twenty years before; to see how he inevitably put his finger on the exact central fundamental lesion which to others was obscured by the many surrounding minor symptoms; a diagnosis made often seemingly by intuition; to follow his treatment until betterment or cure or in rare cases death closed the scene; this was a liberal education in itself.

At my request a list of the men who have been his colleagues or assistants has been furnished to me. I find that they were nearly 160 in number. To call this notable roll in your hearing is of course impossible. But I can not refrain from mentioning a few of the more conspicuous—names known to most of you as leaders not only in this community but throughout this country and not a few of world-wide fame: Wharton Sinkler, Morris J. Lewis, William J. Taylor, J. Madison Taylor, John K. Mitchell, Charles W. Burr, G. G. Davis, F. X. Dercum, George E. deSchweinitz, Charles K. Mills, Barton C. Hirst, John H. W. Rhein, A. P. C. Ashhurst, D. J. McCarthy, Guy Hinsdale, of Hot Springs, Va., Edward B. Angell, of Rochester, N. Y.

I have only named one tenth of this ever-faithful cohort. We, the other 90 per cent., may well rest content, however, in the consciousness of daily duty well done. In the forum of one's own mind and conscience the ultimate and most cherished judgment seat is established.

One noteworthy fact demonstrates how stimulating was his influence. Twenty-five of the men who served this hospital in the eighteen years from 1889 to 1907 contributed 522 papers to medical and surgical literature. Not all, not even a majority of these were papers on neurology or orthopædics, but the incentive, the stimulus to writing, was largely the result of Mitchell's precept and example.

While I was on the active staff the daily out-patient service was constantly growing larger and larger. The noise and confu-

sion, the dirt, especially on rainy and muddy days, were increasing and the desire for separate quarters for this daily throng was constantly growing more insistent.

Up to the end of 1908 while the house patients totaled 10,936 there had been 180,555 patients cared for in the out-patient clinics. This is a large number, but it covers many years. For the last year, 1915, the number cared for in this clinic was only 150 less than 26,000, largely over 2,000 patients every month! For the seven years from 1909 to 1915 the total number was 156,385. This year, 1916, will bring up the number for the past eight years to more than had been treated in the 42 years after the little hospital was started on Ninth Street in 1867.

When Dr. Mitchell passed away early in 1914 the opportunity came for relieving the hospital itself from this burden and at the same time for founding a worthy and spontaneous memorial in the hospital to which he had given of his best for so many years of his busy life. A large committee, numbering fifty to sixty, consisting of the members of the board, the members of the medical and surgical staff and assistants and many women was formed with Dr. Charles W. Burr as chairman, Mr. Charles Sinkler as secretary, and Mr. John W. Brock as treasurer. Through their abounding efforts even in the depressing financial conditions preceding the Great War the money to erect the memorial was obtained.

Right opposite to the hospital, across Seventeenth Street, stood the parish house of the chapel of the Epiphany Episcopal Church, unused and for sale. The lot measures 80 feet, 9 inches on Seventeenth Street and is 107 feet deep. It was purchased for $40,000. The alterations, furnishings and equipment have cost about $20,000 additional, a total, therefore, of $60,000. It is away from and not physically a part of the hospital, yet is within a few steps; convenient of access yet keeping all noise, dirt and possibility of contagion away from the house patients, whose quiet comfort and speedy recovery are thereby greatly promoted.

Had Dr. Mitchell himself been consulted, no memorial more pleasing to him could have been devised. No stately mausoleum, useless alike to the living and the dead, would have appealed to him. A busy clinic where thousands upon thousands will be helped back to joyous life because it is a useful life—this I am sure he would have thought the most grateful homage from his many friends.

W. W. KEEN

A NOTE ON THE SERUM TREATMENT OF POLIOMYELITIS (INFANTILE PARALYSIS)[1]

THE epidemic of poliomyelitis that is prevailing at the present time so extensively in New York and in some degree widely throughout the United States has led to many inquiries being made regarding the serum treatment of the disease, and particularly of the stage to which the treatment has advanced. This brief paper is intended not only to answer such inquiries, but also to provide a basis for the wider employment of the treatment where the difficult conditions surrounding the obtaining of the immune human serum can be surmounted.

It was demonstrated by Flexner and Lewis,[2] and afterwards confirmed by several investigators, that monkeys which had recovered from an attack of poliomyelitis induced experimentally were not subject to successful reinoculation with the virus of the disease. This was followed by the detection by Römer and Joseph[3] and later by others in the blood of

[1] From The Rockefeller Institute for Medical Research, New York.

[2] Flexner, S., and Lewis, P. A., "Epidemic Poliomyelitis in Monkeys," fourth note, *J. A. M. A.*, 1910, LIV., 45.

[3] Römer, P. H., and Joseph, K., *Münch. med. Woch.*, 1910, LVII., 568. Levaditi and Landsteiner, *Comp. rend. Soc. de biol.*, 1910, LXVIII., 311. Flexner, S., and Lewis, P. A., "Experimental

such resistant or protected monkeys, and then by Levaditi and Netter,[4] and by Flexner and Lewis in the blood of human beings who had recovered from acute poliomyelitis, of immunity substances which possessed the power of neutralizing the virus of poliomyelitis when the serum and the virus were brought together in the test tube. Flexner and Lewis ascertained, also, that the serum of monkeys actively immunized[5] with the virus under conditions in which all symptoms of the disease were avoided, contained similar immunity bodies.

EXPERIMENTAL SERUM THERAPY

The next step taken was the determination by Flexner and Lewis that both the immune monkey[6] and the immune human serum[7] which exhibited the neutralizing power for the virus possessed also therapeutic properties for monkeys inoculated with the potent virus of poliomyelitis in contradistinction to the normal serum from the same animal sources which was devoid of those properties.

The experimental demonstration of the therapeutic activity of the immune sera was made in the following manner. Rhesus monkeys were inoculated (*a*) intracerebrally and (*b*) intranasally with a virus which had become adapted to the monkey and was highly potent. The effective intracerebral dose of a Berkefeld filtrate of a 5 per cent. emulsion of the spinal cord of an infected monkey was less than 0.01 c.c. Hence the quantity of the filtrate injected into the brain of the etherized monkeys varied from 0.01 to 0.1 c.c. The inoculations were made in the afternoon and the therapeutic treatment was begun the next day, or from eighteen to twenty-four hours later. When the virus was introduced by the nasal route the filtrate was not employed, but an emulsion of the spinal cord was rubbed upon the upper nasal mucosa.

The immune sera were applied by intraspinal or subdural injection. The usual method was to inject from 2 c.c. to 3 c.c. of the immune sera through the lumbar puncture needle daily for several days or daily for three injections followed by an interval of three days when the three injections were repeated. The conclusions reached from these experiments were in substance that if the quantity of virus is not in excess of a given dose, the infection can be either wholly prevented or the onset of the paralysis much delayed. In other words when dealing with the virus adapted to the monkey which induces poliomyelitis almost without exception and in which the symptoms are far more severe and the mortality far greater than occur in the disease in human beings, the immune monkey and human sera are capable of preventing in all but a few instances the development of the virus even when inoculated intracerebrally, and in the exceptional instances in which the development is not wholly prevented, the onset of the disease is much delayed. The power, therefore, to neutralize the virus possessed by the immune sera is exercised *in vivo* under severe experimental conditions almost as constantly as *in vitro* under relatively favorable ones.

In order that maximal effect of the immune sera may be secured it is necessary that the injections be made into the subdural space which can be readily and safely accomplished by means of lumbar puncture. The reason for this mode of application of the serum depends upon the facts that it is the most direct route to the central nervous tissues and, however the virus is introduced into the body, it establishes itself in the cerebrospinal meninges.[8]

Poliomyelitis in Monkeys,'' seventh note, *J. A. M. A.*, 1910, LIV., 1780.

[4] Levaditi and Netter, A., *Presse med.*, 1910, XVIII., 268. Flexner, S., and Lewis, P. A., seventh note, *loc. cit.*

[5] Flexner, S., and Lewis, P. A., ''Experimental Poliomyelitis in Monkeys,'' eighth note, *J. A. M. A.*, 1910, LV., 662.

[6] Flexner, S., and Lewis, P. A., seventh note, *loc. cit.*

[7] Flexner, S., and Lewis, P. A., eighth note, *loc. cit.*

[8] Flexner, S., and Lewis, P. A., seventh note, *loc. cit.* Flexner, S., ''The Contribution of Experimental to Human Poliomyelitis,'' *J. A. M. A.*, 1910, LV., 1105. Flexner, S., and Amos, H. L., ''Penetration of the Virus of Poliomyelitis from the Blood into the Cerebrospinal Fluid,'' *Jour. Exper. Med.*, 1914, XIX., 411.

It is logical, therefore, to endeavor to bring the immune serum in as high a concentration as possible into immediate relation with the seat of disease.

The power of the immune serum, when injected subdurally, to prevent the development of experimentally induced poliomyelitis in the monkey, is further indicated by experiments[9] in which, on the one hand, the virus has been injected into the blood under conditions insuring its escape into the meninges and, on the other, when an emulsion of the virus has been introduced directly into the meninges and followed later by the serum injection.

SERUM THERAPY IN MAN

This aspect of the subject has been imperfectly developed up to the present time. Netter[10] was the first to apply the data obtained by experiments on monkeys to the treatment of cases of epidemic poliomyelitis in man. He has published the results obtained in a series of thirty-five cases which he regarded as highly favorable to the method. He employed the serum from cases of poliomyelitis in which complete recovery from the acute condition has taken place some time and even as long as thirty years previously. The serum injections were given subdurally as early after the appearance and recognition of the symptoms of poliomyelitis as possible. The dose of the serum, which must, of course, be sterile but need not be inactivated, should be determined by the age of the patient and will, in part, be determined by the quantity of serum available. Probably doses ranging from five to twenty cubic centimeters will be found suitable, the injection to be repeated once or more times at twenty-four hour intervals according to clinical conditions and indications. The effects of the immune serum should be sought in the checking of the progress of the disease, namely the prevention or minimization of the paralysis when employed in the preparalytic stages, and the arrest of its extension when used in progressing paralytic conditions. Since the immunity substances have been determined by neutralization tests to persist in the blood for many years, it is probable as Netter has indicated that persons who have passed through an attack of poliomyelitis several years earlier may be utilized as sources of the serum; while reasoning from analogy it would probably be advantageous to prefer persons whose attack was less remote so as to insure as high concentration of the immunity bodies as possible. The conditions surrounding the injection of the serum are identical with those observed in the analogous case of epidemic meningitis. Before each dose of serum is injected a suitable quantity of cerebro-spinal fluid is to be withdrawn, and the injection should be made slowly. In choosing the person who is to serve as the source of the blood from which the immune serum is to be derived precaution should of course be taken to secure a healthy donor; it would be advisable to fortify the usual clinical examination by a Wassermann test.

SIMON FLEXNER

[9] Flexner, S., and Amos, H. L., "Localization of the Virus and Pathogenesis of Epidemic Poliomyelitis," *Jour. Exper. Med.*, 1914, XX., 249.

[10] Netter, A., "Serotherapie de la poliomyelite nos resultants chez trentedeux malades," Indications technique—incidents possibles, *Bull. de l'Acad. de Med.*, Oct. 12, 1915. Netter, A., and Salanier, M., "Deux nouveaux cas de poliomyelite a debut meninge gueris par les injections intrarachidiennes de serum d' anciens malades," *Bull. Mem. Soc. Med. des Hop. de Paris*, Mar. 10, 1916.

THE CULTURE VALUE OF SCIENCE[1]

WISHING not to squander any of the few minutes allowed me in this program, I have written down what I have to say, and hope you will pardon me if by reading I seem unduly formal for the occasion.

The Scripps Institution for Biological Research believes it has a mission over and above what is indicated by its name. As "nominated in the bond," its function is to produce new knowledge in the realms of nature with

[1] Remarks to the teachers of science in the secondary schools of southern California on the occasion of their visit to La Jolla and the Scripps Institution for Biological Research of the University of California during the teachers' institute week in November, 1915.

which it is occupied. But it would do something also toward the humanization of science. Its work is not only to *make* science, but to make science *human*. Concerning its science-producing function you will learn something to-day from the other members of the staff. So the time at my disposal may be devoted to saying a little about what we mean by humanizing science.

First, I remark on the eagerness with which we avail ourselves of this opportunity to help you, teachers of science in the secondary schools, to become acquainted with the institution. We know well enough that if ever our theories about the humanization of science are to be realized, the teachers of boys and girls must be a large, probably the largest, factor in doing it.

Despite the stupendous development of physical science in our day, there is wide-reaching, deep-seated misconception as to what science is; and this misconception is not confined to the laity. It pervades the fold of science itself. This assertion may surprise you; but I believe a little reflection will convince you of its truth. Being teachers, you do not need to be told that the curricula of practically all schools make the sharpest distinction, expressly or tacitly, between humanistic subjects and scientific subjects; between cultural and practical studies, science being the backbone of most of the practical courses. Have you ever known or heard of a school that considered its science courses to be cultural in a genuine sense? When "culture courses" are spoken of, are the scientific ones ever referred to? If so, it is only in the few instances where some science teacher of exceptional insight and personal force has driven his or her colleagues to accept such a valuation of subjects. So far as my observation has gone, admission of the culture-value of science that is not half-hearted and grudging is so rare as to be practically negligible. And a fact of grave concern is the tendency vocational training has to blindfold scientists and teachers of science into accepting this exclusively physical valuation of science. From this influence and others it happens that science has become the ally, and to a large extent the background, of that theory and practise in the civilization of our day variously spoken of as economism, industrialism, and commercialism. The monstrous power this theory of civilization has for destroying all that is finest and noblest and most cherished in human life is at last being recognized by certain thoughtful persons. But few there are, apparently, who yet see with clear vision the profound importance for the situation of beliefs touching the cultural value of science. One lot of philosophers take the ground that on the whole science is proving itself an enemy to mankind. They say the undeniable good science has done in providing man with more and better things to eat and wear, better dwellings, better means of communication, more abundant material wealth, greater immunity from disease, and so forth, are insufficient to offset the harm it does in robbing him of aspirations, ideals, faiths, sensitiveness to beauty in nature and in art, and love of his fellow beings. Just how numerous and influential these philosophers are, is difficult to estimate; but without doubt a sentiment of this kind is widespread in the community. It seems to have been growing during the last few decades; and the three-continent-wide struggle now raging is unquestionably helping it on. The dreadnaught service, the submarine service, the air-machine service, the giant artillery service, the poisonous-gas service, and the rest, are making evident to the whole world how efficient the several departments of Hell can be made by making them thoroughly scientific. "Poor science," said a writer for a Socialist paper the other day, "is too busy working in the service of militarism, perfecting instruments of destruction," to do much toward the advancement of civilization. I am sure science is less honored, less prized to-day, for any purpose not commercial or purely physical in some way, than it was when I was young; and to one aspect of the matter I would direct your special attention.

Beyond a doubt these later years have witnessed a flocking of people in increasing numbers to occult and mystical doctrines and practises of various sorts. Make the rounds of the bookshops in almost any city and you will find

writings of this character more numerously and conspicuously displayed than works on scientific subjects other than those of applied science and school text-books. Judging from the testimony of publishers and book-dealers, the public is finding little in modern science that satisfies the deepest needs of human life. I want to insist that a radical change will have to be wrought in the feeling of educated people generally toward science, if civilization is to rise much above its present level.

But estimation of the worth of science can be changed only as an incident to a profound change of conception of and feeling for nature. Let no one, especially no teacher of science, fail to make the sharpest distinction between *nature* and *science*—between nature itself and knowledge of nature!

I just mentioned *feeling* for nature. Here, I am persuaded, is the key to the situation. I wonder to what extent you have noted that the scientific authorities you read and meet rarely love nature. If they do, they rarely say so, or reveal their feeling in any way. In fact, it would be surprising if you have not been admonished by your leaders that *feeling* must be frozen out of science. With many a scientist the stigma that attaches to the phrase "nature lovers," from having been applied to a group of slop-overs has been extended to everybody who manifests love for nature in any way.

We touch a subject here too vast to do much with in a talk like this. I can only remark that practical experience and the psychology of feeling demonstrate the utter fallacy of the theory that science must be emotionless. Have you yourself or has anybody you ever saw or heard of, done thoroughly well any task into which the "whole heart," as we say, has not entered? But the "whole heart" is, as modern psychology is making us understand, the unerring folkway of saying that the feelings, the affective side of our natures, though not the intellect, must be ever present along with intellect in all high and effective endeavor. And I urge you to mark well this fact: The very men of science who depreciate love of nature do not hesitate to extol love of truth. Truth, they say, not only may be, but must be loved that its pursuit, even by science, shall be assured. We hear men preach love of truth and of emotionless science, almost in the same breath!

But what is truth? The query has beset all the sages of all the ages. Curiously enough, when you come to reflect, the sages who have sweated blood over this question have not been students of nature at all as modern science understands the phrase. The sages have looked at a few aspects of nature and have speculated endlessly and earnestly about nature; but they have not studied it.

Let a humble naturalist try his hand at defining truth. *Truth* (with as big a *T* as you please) *is all that has been learned plus all that remains to be learned about nature.* At the particular institution of scientific research which you visit to-day, the theory is held that nature and truth, while not identical, yet have so much in common—overlap each other in so much of their range—that whatever place *feeling* rightly has in the pursuit of the one, it has in the pursuit of the other. And here is the most vital spot of all: Men love truth because truth is to their advantage. It is beneficent—it makes goodness in their lives. Exactly so with nature according to our theory. Nature is beneficent. It is a maker of goodness in human lives. Indeed, excepting through nature, there is no goodness; and the chief end of science is to show in detail and literally how we live, move and have our being in nature. Through the achievements of modern medicine and hygiene and agriculture and industrial chemistry and mechanics, the most enlightened persons seem to have become convinced at last that nature is man's preserver and sustainer. It remains now for them to become convinced that nature is man's maker as well as his sustainer. This task falls more heavily on biology than on any other science.

So I ask that while you look over the "plant" of the Scripps Institution to-day and while you work toward a decision on whether or not you can accept the invitation we hope to extend to you before long to spend a little time at the institution next summer on some

work with us, you keep constantly before you the ideas and ideals of the institution here so sketchily described.

Wm. E. Ritter

La Jolla, Calif.

THE NATIONAL RESEARCH COUNCIL

On April 19, 1916, at the closing session of the annual meeting, the National Academy of Sciences voted unanimously to offer its services to the president of the United States in the interest of national preparedness. The council of the academy was authorized to execute the work in the event of the president's acceptance.

On April 26 the president of the academy, accompanied by Messrs. Conklin, Hale, Walcott and Woodward, was received at the White House by the president of the United States. In presenting the resolution adopted at the annual meeting, it was suggested that the academy might advantageously organize the scientific resources of educational and research institutions in the interest of national security and welfare. The president accepted this offer, and requested the academy to proceed at once to carry it into effect.

Immediately following this visit, the president of the academy, in harmony with resolutions adopted by the council on April 19, appointed the following organizing committee: Messrs. Edwin G. Conklin, Simon Flexner, Robert A. Millikan, Arthur A. Noyes and George E. Hale (*chairman*).

At a meeting of the council of the academy, held in New York on June 19, the organizing committee presented the following statement of work accomplished up to that date.

Much time was devoted during the first five weeks to the organization of committees to meet immediate needs, including those on Nitric Acid Supply (A. A. Noyes, chairman), in cooperation with the American Chemical Society; Preventive Medicine (Simon Flexner, chairman), in cooperation with the Committee of Physicians and Surgeons, and Synthetic Organic Chemistry (M. T. Bogert, chairman), in cooperation with the American Chemical Society. Special attention was also given to arrangements for cooperation with the scientific bureaus of the government, the committee of physicians and surgeons, the naval consulting board, the national societies devoted to branches of science in which committees were immediately needed, the national engineering societies, the larger research foundations, certain universities and schools of technology, and the leading investigators in many fields of research, both on the industrial and the educational side. The hearty encouragement received from all of these men and institutions leaves no doubt that, as soon as a general request for cooperation is sent out, it will meet with universal acceptance.

During this preliminary period a more comprehensive plan of organization was developed, and finally embodied in the form indicated below. It was recognized from the outset that the activities of the committee should not be confined to the promotion of researches bearing directly upon military problems, but that true preparedness would best result from the encouragement of every form of investigation, whether for military and industrial application, or for the advancement of knowledge without regard to its immediate practical bearing. The scheme of organization must be broad enough to secure the cooperation of all important agencies in accomplishing this result.

After considering a variety of plans the organizing committee presented to the Council of the Academy the following recommendations:

That there be formed a National Research Council, whose purpose shall be to bring into cooperation existing governmental, educational, industrial and other research organizations with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defense, and such other applications of science as will promote the national security and welfare.

That the council be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution and various scientific bureaus of the government; educational

institutions and research endowments; and the research divisions of industrial and manufacturing establishments.

That, in order to secure a thoroughly representative body, the members of the council be chosen in consultation with the presidents of the American Association for the Advancement of Science, the American Philosophical Society, the American Academy of Arts and Sciences, the American Association of University Professors, and the Association of American Universities; that representatives of industrial research be selected with the advice of the Presidents of the Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Society of Electrical Engineers, and the American Chemical Society, and that members of the cabinet be asked to name the representatives of the various departments of the government.

That research committees of two classes be appointed, as follows: (*a*) Central committees, representing various departments of science, comprised of leading authorities in each field, selected in consultation with the president of the corresponding national society. (*b*) Local committees in universities, colleges and other cooperating institutions engaged in scientific research.

The organizing committee also recommended the following plan of procedure, subject to such modifications as the National Research Council may deem desirable.

1. The preparation of a national inventory of equipment for research, of the men engaged in it, and of the lines of investigation pursued in cooperating government bureaus, educational institutions, research foundations and industrial research laboratories; this inventory to be prepared in harmony with any general plan adopted by the proposed government council of national defense.

2. The preparation of reports by special committees, suggesting important research problems and favorable opportunities for research in various departments of science.

3. The promotion of cooperation in research, with the object of securing increased efficiency; but with careful avoidance of any hampering control or interference with individual freedom and initiative.

4. Cooperation with educational institutions, by supporting their efforts to secure larger funds and more favorable conditions for the pursuit of research and for the training of students in the methods and spirit of investigation.

5. Cooperation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

6. The encouragement in cooperating laboratories of researches designed to strengthen the national defense and to render the United States independent of foreign sources of supply liable to be affected by war.

The council of the academy voted to accept the proposals of the organizing committee, and instructed it to proceed with the formation of the National Research Council in accordance with the plan recommended by the committee.

In consultation with the presidents of the various societies already mentioned, most of the members of the council have now been chosen.

The endorsement of the president of the United States and the authority to secure the appointment of government representatives is conveyed in the following letter to the president of the academy:

WASHINGTON, D. C., July 24, 1916.

DR. WILLIAM H. WELCH,
President of the National Academy of Sciences,
Baltimore, Maryland.

MY DEAR DR. WELCH:

I want to tell you with what gratification I have received the preliminary report of the National Research Council, which was formed at my request under the National Academy of Sciences. The outline of work there set forth and the evidences of remarkable progress towards the accomplishment of the object of the council are indeed gratifying. May I not take this occasion to say that the departments of the government are ready to cooperate in every way that may be required, and that the heads of the departments most immediately concerned are now, at my request, actively engaged in considering the best methods of cooperation.

Representatives of government bureas will be appointed as members of the Research Council as the council desires.

Cordially and sincerely yours,
[Signed] WOODROW WILSON

Under this authority, the appointment of representatives of the army, navy and various scientific bureaus of the government will now be arranged with the members of the cabinet.

It is expected that the first meeting of the council will be held in September.

It has already been stated that cordial desire to cooperate has been encountered on every hand. Special reference may now be made to certain striking cases. The first of these illustrates how the council, taking advantage of the increased appreciation of the value of science and the spirit of national service which have resulted from the war, may obtain the cooperation of educational institutions and assist them in adding to their endowments for scientific research. Throop College of Technology, in Pasadena, California, is a small institution of high standards which gives special attention to research. President Scherer, hearing of the plans of the research council, offered the assistance and cooperation of the recently endowed research laboratory of chemistry and secured at once an additional endowment of one hundred thousand dollars for scientific research. Under somewhat similar circumstances, a gift of $500,000 has been made to the endowment of the Massachusetts Institute of Technology, with the expectation that much of the income will be used for research at that institution.

Another illustration of friendly cooperation, of special importance because it assures the support of the national engineering societies, is afforded by the following resolution of the Engineering Foundation of New York, adopted at the annual meeting of the foundation, on June 21, 1916:

> Whereas, the National Academy of Sciences of the United States of America has taken the initiative in bringing into cooperation existing governmental, educational, industrial and other research organizations with the object of encouraging the investigation of natural phenomena, the application of scientific principles in American industries, the employment of science in the national defense, and such other objects as will promote the national welfare, and
>
> Whereas, these objects are among the objects for which The Engineering Foundation was created,
>
> *Now, Therefore, be it Resolved,* that The Engineering Foundation hereby registers its approval of the coordination and federation of the research agencies of the country undertaken by the National Academy of Sciences and expresses its willingness to join with and assist the National Academy in accomplishing the above federation.

The foundation also offered to devote its entire income for the coming year (including a special gift of $5,000 for this purpose from its founder, Mr. Ambrose Swasey) toward the expenses of organization, and to provide a New York office for the council in the Engineers Building.

The presidents of the American Philosophical Society, of the American Association of University Professors, and of Yale University have already expressed their intention of proposing the adoption of similar resolutions by the institutions which they represent and of recommending the appointment of committees to cooperate with the National Research Council; and it is expected that other societies and educational institutions will take similar action.

Respectfully submitted by the organizing committee.

George E. Hale (*chairman*),
Edwin G. Conklin,
Simon Flexner,
Robert A. Millikan,
Arthur A. Noyes

George E. Hale

A BRITISH BOARD OF SCIENCE AND INDUSTRY[1]

We have received for publication from the British Science Guild the following memorandum on the relations which should exist in future between the state and science, and suggesting that a national statutory board of science and industry should be formed. The memorandum, which has been forwarded to the government, is signed by some 220 of the most important representatives of industry, science and education:

The British Science Guild, which was founded in 1905 with the object of bringing home to all classes "the necessity of applying the methods of science to all branches of human endeavor, and thus to further the progress and increase the welfare of the empire,"

[1] From *Nature.*

is of opinion that the present European crisis affords a unique opportunity for impressing upon all who are engaged in the executive functions of government, as well as upon those who are concerned with industry and commerce, the paramount importance of scientific method and research in national affairs.

There has been much discussion upon these matters, and the following conclusions are submitted by the Guild as representing authoritative opinion:

A. The material prosperity of the civilized world during the past century is mainly due to the application of science to practical ends.

B. While we stand high among all nations in capacity for original research, as represented by the output of our scientific workers, this capacity has been comparatively little utilized in British industry.

C. The state has neglected to encourage and facilitate scientific investigation, or to promote that cooperation between science and industry which is essential to national development.

D. Modern conditions of existence demand that instruction in science, and training in scientific method, should be a fundamental part of education.

E. The present control of all stages of educational work, from the primary school to the university, mostly by men who have an inadequate appreciation of the meaning and power of science, is largely responsible for the unsatisfactory preparation commonly provided for the work of life.

Since its foundation the British Science Guild has urged that, in the interests of national welfare, serious attention should be given to these defects, and steps taken to remedy them. The establishment of the scheme for the development of scientific and industrial research, under a committee of the Privy Council, is a welcome recognition of the intimate relations between scientific investigation and industrial advance; and the advisory council which advises the committee as to the expenditure of the sums provided by Parliament, amounting for the year 1916–17 to £40,000, has already been responsible for the institution of researches which should lead to most valuable industrial results. The outlook of the council may, however, be extended profitably in several directions; for it should be even more comprehensive than that of the development commission, which provides for the development of rural industries, among other matters. This commission, with the Board of Agriculture and Fisheries, and the Imperial Institute, which has recently been transferred from the Board of Trade to the Colonial Office, is not concerned directly with manufacturing industries, upon which so large a part of the nation's prosperity depends.

The field of the Privy Council committee and its advisory council is thus distinct from that of any existing state department; and it should embrace all progressive industry and science. It is suggested that a board or ministry is necessary to discharge the functions indicated in Clause I. of the recommendations subjoined, in such a way as to fulfil modern requirements.

I. A national statutory board of science and industry, the permanent staff of which should consist mainly of persons of wide scientific knowledge and business experience, should be established to:

1. Promote the coordination of industrial effort.

2. Secure cooperation between manufacturers and all available laboratories of research.

3. Coordinate, and be the executive center of such joint scientific committees as have been formed by the Royal Society, the Chemical Society and various trade and educational associations.

4. Undertake inquiries as to products and materials, and generally to serve as a national bureau of scientific and industrial intelligence.

5. Collect and publish information of a scientific and technical character; and provide so far as possible for the solution of important problems bearing upon industry.

6. Institute a number of paid advisory committees consisting of men of wide scientific knowledge assisted by expert investigators and technologists who should receive reasonable fees for their services.

7. Organize scientific effort on the manufacturing side and in commercial relations with other countries.

8. Arrange measures for the mobilization of the scientific, industrial and educational activities of the nation so as to ensure ready response to national needs and emergencies.

9. Encourage investigation, and, where necessary, give financial aid towards the synthesis and artificial production of natural products and for other researches.

Such a board would naturally administer the scheme of the Privy Council committee, as well as take over certain functions of existing departments and boards.

The functions of the board would be much the same as regards the promotion of scientific and industrial research and training, the cooperation of universities with industries through trade associations, and the maintenance of a record of scientific and technical experts, as outlined in the report on "British Trade after the War," by a subcommittee of the Board of Trade.

II. In all departments of state in which scientific work is carried on, adequate provision should be made for the periodical publication and wide distribution of bulletins, leaflets and reports, so that increased public interest and attention may be encouraged in the results.

III. Every industrial undertaking, subsidized or otherwise assisted by the state, should have upon its board of directors men who possess expert scientific knowledge of the business in which they are engaged.

IV. In order to develop industries which especially require the services of scientific workers, adequate remuneration and improved prospects should be offered by the government, by municipal corporations, and by manufacturers to men who have received an effective scientific training. Means should be found of compensating and rewarding persons whose researches have proved of decided national or public advantage without being profitable to themselves.

V. A knowledge of science should be regarded as an essential qualification for future appointments in the departments of the public service concerned with industrial, scientific and technical developments. The Royal Commission on the Civil Service recommended in 1914 that a committee should be appointed to consider the present syllabus of subjects of examination for clerkships (Class I.). This committee should be constituted without delay, and science as well as other branches of modern learning should be adequately represented upon it, and upon the Civil Service Commission itself.

VI. Measures should be taken to revise the educational courses now followed in the public schools and the universities of Oxford and Cambridge.

VII. In elementary and secondary schools supervised by the Board of Education, more attention should be given to scientific method, observation and experiment, and to educational handwork.

NEW YORK MEETING OF THE AMERICAN CHEMICAL SOCIETY

Official announcement of the meeting of the American Chemical Society, to be held in New York September 25 to 30, in conjunction with the Second National Exposition of Chemical Industries, was issued to the members by Dr. Charles L. Parsons, secretary, on August 15. Dr. Charles H. Herty, of the University of North Carolina, president of the American Chemical Society, will open the exposition on Monday, September 25, at 2 o'clock in the afternoon, with an address reviewing the history of chemistry and the chemical industries in this country, and outlining developments since the outbreak of war in Europe. The presidents of cooperating societies, such as the American Electrochemical Society, the American Institute of Mining Engineers, and the American Paper and Pulp Association, will follow Dr. Herty with speeches of welcome and reviewing the progress made in the industries represented by them.

The first general session of the American Chemical Society will open at Columbia University on Tuesday morning, September 26, and arrangements are being perfected for a public meeting in the large hall of the College of the City of New York on Tuesday afternoon, when addresses will be made of general public interest pertaining to the interesting developments in the field of applied chemistry during recent years.

The program of the week's meetings will provide for general conferences on subjects in which the chemists of the country are now interested, and it is intended that the lecture hall of the Grand Central Palace and Rumford Hall in the Chemists' Club building will be occupied each afternoon at the same time by one or other of the different divisions of the society for the discussion of such industrial topics as the production of dyestuffs, medicinal chemicals, industrial alcohol, the manufacture

of paper pulp and by-products, oils and mofor fuels, glassware and porcelain, steel alloy metals, new developments in chemical industries, etc.

On Wednesday and Thursday mornings a general symposium on colloids will be held, theoretical considerations being discussed on the first day and the industrial applications of colloid chemistry on the second day.

The American Electrochemical Society has planned a series of interesting meetings. The electrochemical group will open its meeting later in the week, on Thursday, September 28, with a technical session devoted to a review of American progress in the electrochemical industry. A complimentary smoker will be held on Thursday evening, and on Friday evening there will be a joint banquet at the Waldorf-Astoria of the members of the American Chemical Society, the American Electrochemical Society, and the Technical Association of the Pulp and Paper Industry.

SCIENTIFIC NOTES AND NEWS

THE funeral of Sir William Ramsay took place at Hazlemere, High Wycombe, on Wednesday, July 26, in the presence of representatives of the Royal Society, the Chemical Society, University College, London, and many other societies and institutions.

GENERAL WILLIAM C. GORGAS, U. S. A., head of the yellow fever commission of the International Health Board of the Rockefeller Foundation, arrived at Bogota, Colombia, from Panama, on August 9. General Gorgas will consult with the Colombian government on sanitary conditions of ports in that country.

PART of the Canadian Arctic expedition, which is led by Vilhjalmur Stefansson, has returned to Nome, Alaska, after spending three years in investigations on the north coast of Canada. Dr. Anderson, of the southern party, reports that Stefannson may not return until some time in 1918. He planned to start from winter quarters in May last to continue his explorations of the new land west of Prince Patrick Island.

THE Astley Cooper prize for the present year, for a treatise on "The Physiology and Pathology of the Pituitary Body," has been awarded to Dr. W. Blair Bell, of Liverpool.

MR. JAMES MOONEY, of the Bureau of American Ethnology has been in North Carolina to continue his researches among the Cherokee Indians.

DR. LEO J. FRACHTENBERG, who has been in the field for the Bureau of American Ethnology for the past year, has changed his headquarters to Portland, Oregon.

MR. C. B. WILLIAMS has been appointed by the Board of Agriculture, Trinidad, to study the parasites of the sugar-cane froghopper in that island.

M. C. WHITAKER, professor of chemical engineering, Columbia University, has been granted leave of absence for the first term of the academic year, 1916–17.

PROFESSOR W. S. MILLER, of the department of anatomy at the University of Wisconsin, has been giving a series of illustrated lectures before the Robert Koch Society for the Study of Tuberculosis, at Chicago, on "The Lymphatics and Lymphoid Tissue of the Lung and their Relation to Disease Processes," and an illustrated lecture before the Cincinnati Research Society on "The Anatomy of the Lungs with special reference to the Lymphatics."

THE Eugenics Education Society of Chicago holds its meetings once a month. Special speakers at these meetings during the current year have been Professor James A. Field, Professor John M. Coulter, Professor Frank R. Lillie, Professor Frederick Starr, Dr. Albert J. Ochsner, Alexander Johnson and Professor Judson Herrick.

WE learn from *Nature* that on Wednesday, July 26, the memorial to Sir William White, promoted by the Institution of Naval Architects, was formally handed over to the council of the Institution of Civil Engineers. The presentation was made by Admiral Sir Reginald Custance and Earl Brassey, who stated that £3,000 had been collected. The money is to be allotted to the foundation of a research scholarship fund, the provision of a memorial medallion to be placed in the hall of

the Institution of Civil Engineers, and a grant to Westminster Hospital. The memorial was accepted by Mr. Alexander Ross, the president of the Institution of Civil Engineers, and now occupies a position on the right hand of the entrance hall. The medallion consists of a portrait of Sir William, carved in relief in white stone, with a warship visible in the distance. The carving is mounted on grey marble, and carries underneath it a tablet, on which are inscribed the words: "Sir William Henry White, K.C.B., LL.D., D.Sc., F.R.S., President, 1903–1904, Director of Naval Construction, 1885–1902. A Tribute from the Shipbuilders of Many Nations." Above is a scroll bearing the motto, "Build Staunch, Build True."

George Anthony Hill, at one time assistant professor of physics in Harvard University, the author of a number of text-books in physics and mathematics, died on August 17, aged seventy-four years.

John P. D. John, at one time professor of mathematics and astronomy in DePauw University and later president of the institution, died on August 7, at the age of seventy-three years.

Johannes Ranke, professor of anthropology at Munich, has died aged eighty years.

Sir William Henry Power, F.R.S., distinguished for his contributions to sanitation and public health, died on July 28, aged seventy-four years.

Rowland Trimen, F.R.S., formerly curator of the South African Museum, author of works on the butterflies of South Africa, died on July 25, at the age of seventy-six years.

Edgar H. Harper, professor of mathematical physics in University College, Cork, known for his work on aviation, has been killed while serving as lieutenant.

F. W. Caton, for a time connected with the Welcome Chemical Research Laboratory, and later lecturer on chemistry and inspector under the Staffordshire Educational Committee, was killed on June 28, while serving as second lieutenant in the British army.

Geoffrey W. Smith, fellow of New College, Oxford, captain in the British Army, has been killed in France. Dr. Alfred G. Mayer writes: "In his death biology loses one of its ablest students, his researches upon the effects produced by parasites upon the secondary sexual characters of crustacea being a classic of science. He was among the first of the university men to enter the service of his nation, and in a letter to me he expressed his regret at leaving his studies, but 'England had need of many junior officers and many of these must be killed, so I must go as soon as possible.' High as his scientific attainments were, few men have been endowed with the rare charm of personality he possessed, and thus doubly must we mourn him."

The Susquehanna River Archeological Expedition, in charge of Messrs. W. K. Moorehead, Alanson Skinner and George P. Donehoo, finished its work on August 1. The party consisted of nine men, and began work at the head of the river, Otsego Lake, New York state. A preliminary survey was made of the entire river, from its source to Chesapeake Bay. Local students and collectors cooperated with the expedition at various points. The party examined a large number of sites along the Susquehanna, and exposed ancient villages attributed to the Delaware, Shawnee, Iroquois and Andaste Indians. A collection of several thousand specimens was secured for the Museum of the American Indian, Heye Foundation. The most important discovery during the journey was the location and excavation of an Andaste cemetery, near Athens, Pennsylvania, where fifty-seven skeletons were unearthed, with interesting specimens of Iroquoian pottery, pipes and stone implements. Contrary to absurd newspaper reports, none of the skeletons were abnormal, nor were they found in a mound. One of the burials, of the so-called "bundle" type, was of unusual interest, since it was covered by a deposit of the antlers of the Virginia deer.

The annual general meeting of the Society of Chemical Industry was held in Edinburgh on July 19–21. According to the account in *Nature*, the meeting this year took the form

of a congress on the progress made since the outbreak of war in British chemical industry. The following papers were read and discussed: (1) *Fuel.*—Fuel economy: a national policy required, Professor H. E. Armstrong; Some recent improvements in coke works practise, Dr. G. P. Lishman; Waste in coal production, Professor H. Louis. (2) *Shale Oil.*—The shale oil industry, D. R. Steuart. (3) *Tar Distilling.*—A short review of the influence exerted by the war on the tar distilling industry, W. H. Coleman; The extraction of tar fog from hot gas, G. T. Purves. (4) *Dyes.*—The difficulties of coal-tar color-making in war-time, C. M. Whittaker (British Dyes, Ltd.). (5) *Fine Chemicals.*—Notes on the production of alkaloids as affected by the war, D. B. Dott; The manufacture of synthetic organic drugs as affected by the war, F. H. Carr; The manufacture of fine chemicals in relation to British chemical industry, C. A. Hill and T. D. Morson. (6) *Paper-making.*—The paper-mill chemist in war-time, J. F. Briggs. (7) *Patent Law.*—The overhauling of our Patent Law, J. W. Gordon; The influence of the Patent Laws upon industry, W. F. Reid; Proposed amendments to English Patent Law, W. P. Thompson. (8) *Rare Earths.*—The progress of British rare-earth industry during the war, S. J. Johnstone. To illustrate the progress that has been made, an exhibition was held, at the same time, of specimens of British-made coal-tar dyes, glass, porcelain and filter paper, along with several other interesting substances now made in Edinburgh. Among these may be mentioned cobalt-blue—a substance never before manufactured in this country—now made by the Beaverhall Color Co.; trinitrotoluene by the Lothian Chemical Co.; erasers, etc., manufactured by the North British Rubber Co., the supply of which formerly was entirely imported from Germany.

THE recovery of the valuable by-products from American coke manufacture made big advances in 1915 and has now attained the proportions of an important industry. The value of these by-products last year was nearly $30,000,000, a large increase over the previous high-water mark of $17,500,000 in 1914. Although there were material increases in the output and value of gas, tar and ammonia, which was to be expected with a greater output of by-product coke, the increase in benzol products was remarkable and presented the most interesting feature of the year in the coke industry. The value of these products rose from less than $1,000,000 in 1914 to more than $7,760,000 in 1915, according to C. E. Lesher, of the United States Geological Survey, Department of the Interior. Benzol has been recovered in this country from coke-oven gas for a number of years, but prior to 1915 the market was small and the prices low. The awakening of the American people to the need for a dye industry and to a realization that such an industry can not spring full-grown from nothing but must be fostered and developed is now a well-known story. Few are aware, however, of the progress that has been made within a year in laying the foundations for future progress in that industry. Under the spur of almost fabulous prices for benzol products, retort coke-oven plants throughout the country quickly installed elaborate benzol-recovery systems and now save the valuable oils that not very long ago were being buried or wasted, or, if saved, were begging for a market. The benzol products obtained in 1915 amounted to 16,600,657 gallons. More than 13,000,000 gallons of the total output was reported as crude light oil and had an average value of 33 cents. Some of the plants have their own stills and refineries, and the pure benzol reported from those sources amounted to 2,516,483 gallons, with an average value of nearly 57 cents, at least three times the value of crude benzol before the war, and 623,506 gallons of toluol, with an average value of $2.45 a gallon. Crude benzol, which in 1914 was used to some extent for motor fuel, contained the toluol, which is now separated out and sold at fancy prices. More than 138,000,000 gallons of tar was obtained from coke ovens and sold for $3,568,384 in 1915. The ammonia, of which nearly 100,000 tons was reported as sulphate and the remainder as liquor (10,626,612 gallons) and anhydrous ammonia (30,002,196) pounds), brought a total of $9,867,475 to the producers.

Surplus gas to the extent of 84,356,000,000 cubic feet, valued at $8,625,000, was sold or used. Of that quantity 17,196,000,000 feet was used as illuminating gas, 27,591,000,000 feet as domestic fuel, and 39,569,000,000 feet as fuel for steam raising, open-hearth furnaces, gas engines, and other industrial purposes. These by-products, which had a total value of $29,824,579, were obtained by the carbonization of 19,500,000 tons of coal, from which was also obtained 14,000,000 tons of coke, valued at $48,500,000. The total value of the coke and by-products was more than $78,300,000.

The production of bituminous coal and anthracite in the United States in 1915 amounted to 531,619,487 short tons, valued at $686,691,186, an increase, compared with 1914, of 18,094,010 tons or 3.5 per cent., in quantity, and of $5,200,543, or 0.8 per cent., in value, according to C. E. Lesher, of the United States Geological Survey. Of this total output, 442,624,426 short tons, valued at $502,037,688, was bituminous coal and lignite, and 88,995,061 tons, valued at $184,653,498, was Pennsylvania anthracite. Pennsylvania, with an output of 157,955,137 tons of bituminous coal and 88,995,061 short tons of anthracite, ranks first among the coal-producing states. West Virginia, with a production of 77,184,069 tons; Illinois, with 58,829,576 tons; Ohio, with 22,434,691 tons, and Kentucky, with 21,361,674 tons, follow in order of production. Thirty states and the territory of Alaska contributed to the total, of which number 13 states and Alaska had increased production, and 17 had decreased production, compared with 1914. To produce this coal, 734,008 men were employed for an average of 209 days.

The second Interstate Cereal Conference will be held at the University of Minnesota, University Farm, St. Paul, July 11, 12 and 13. At this conference there will be a discussion of the various phases of cereal research relating to the region of which St. Paul may be considered the center. The program will include papers on problems of wheat, oats, barley and flax production in the Northwest; the grading of barley and corn; breeding winter wheats for Minnesota; ergot of rye; methods for the eradication of bunt or stinking smut; problems in flax diseases, and a symposium on milling and baking. Two days will be devoted to the presentation and discussion of papers. The third day will be used in an inspection of the plant work of the Minnesota Agricultural Experiment Station and of one of the local flour mills.

Receipts from national forests for the fiscal year 1916 reached the high-water mark of approximately $2,820,000, according to figures just compiled. This is $341,000 above the 1915 total, which in turn exceeded any previous year. Officials say that the gain was due to increased demand for all classes of forest products. There was a decided growth in the revenue from all sources, the largest being that of $203,000 in timber sales. Grazing fees showed a gain of $77,000. Receipts for water power development were over $12,000 more than for 1915. Sales of turpentine privileges and charges for special uses were both considerably in excess of the previous year. The National forests are important factors in the prosperity of the regions in which they are located, on account of the large amounts of timber, range and other resources which they hold available for use as needed. Business conditions are reflected in the receipts of the forests. Consequently the showing for the past year is regarded as an index of increased business activity throughout the sections where the national forests are found.

UNIVERSITY AND EDUCATIONAL NEWS

Columbia University has received $100,000 from Mr. James N. Jarvie, the banker, for the new dental school, plans for which were announced last spring.

The Municipal University of Akron is about to erect an engineering laboratory at the cost of $50,000, provided by a bond issue of the city. The new library building, erected at a cost of $40,000, is now open for use.

Princeton University announces that October 26 has been set aside as the day for the laying of the corner stone of the handsome new student dining halls, now being erected at the corner of Nassau Street and University

Place. The dining quarters and the kitchens will be far enough advanced to accommodate the number of undergraduates who formerly took their meals at "Commons," comprising about one thousand students.

DR. WALTER A. JESSUP, dean of the college of education at the State University of Iowa, has been elected president of the university, to succeed Dr. Thomas H. Macbride, the botanist, who retires at the age of sixty-eight years.

HOWARD C. PARMALEE, of Denver, has been elected president of the Colorado State School of Mines at Golden.

AT Dartmouth College, Charles N. Haskins has been promoted to be professor of mathematics on the Chandler foundation, Norman E. Gilbert has been promoted to be associate professor of physics and Arthur B. Meservey to be assistant professor of physics. Carl C. Forsaith has been appointed instructor in biology.

W. S. MILLER, of the department of anatomy, at the University of Wisconsin, has been promoted from associate professor to professor of anatomy.

STANLEY C. BALL, Ph.D. (Yale, '15) has been appointed instructor in zoology in the Massachusetts Agricultural College. Frank N. Blanchard (Tufts, '13) has resigned from the department in order to enter the graduate school of the University of Michigan.

DR. T. G. MOORHEAD has been elected professor of the practise of medicine in the School of the Royal College of Surgeons in Ireland, in the place of Sir John Moore, who has retired.

DISCUSSION AND CORRESPONDENCE

NORTH AMERICAN FAUNAL AREAS

A VERY interesting discussion of the geographical distribution of the fresh-water faunas of North America[1] has recently been published by Mr. Louis Germain. This author reviews the works on this subject by American authors in a very able manner and the paper is a valuable contribution to the literature of this subject. There are several statements, however, which probably will not be accepted by all American zoologists. Germain accepts Simpson's[2] division of the continent into the Pacific, Atlantic and Mississippian regions as representing the best and only natural division into faunistic areas. The subdivisions by Dall[3] and Baker[4] are believed to be too complex; and the latter author is criticized for establishing so complex a subdivision of the territory based on the data supplied (apparently) by a single small division of animals. But the facts are that the map on page 57 of the Lymnæa monograph was made not only from data furnished by the Lymnæas, but also by all of the families of basommatophorous mollusks, *Planorbis, Physa,* etc., the data for which was secured while working upon the Lymnæid monograph. Not only, however, do the families of Basommatophora fit into this detailed scheme, but it is quite possible that all of the fresh-water mollusks, gastropods as well as pelecypods, may be included. The Amnicolidæ, Pleuroceridæ and Viviparidæ, as well as the great Unionidæ family, have many groups of species which are confined to some one of the divisions indicated by the map in question.

As the writer has already stated in the Lymnæa monograph, the distribution of fresh-water mollusks, or for that matter of any fresh-water group of animals, can be understood only by a study of the river systems, past and present. It is more frequently the natural divides separating river drainages that form the boundaries of faunal areas rather than the presence of mountain chains, which indeed do not always afford a barrier, but a means of communication, as, for example, Two Ocean Pass in Wyoming, at the summit of the continental divide, where the head waters of the

[1] "L'Origine et la Distribution Géographique des Faunas d'eau Douce de L'Amérique du Nord," *Annales de Géographie,* No. 32, XXIII–XXIV. année, pp. 394–406, 1915.

[2] C. T. Simpson, "Synopsis of Naiades," p. 505.

[3] W. H. Dall, "Land and Fresh-water Mollusks of Alaska," p. 1.

[4] F. C. Baker, "Lymnæidæ of North and Middle America," p. 56.

Yellowstone and Snake rivers mingle during the wet season and afford a means by which fresh-water animals have crossed from one drainage to the other. The dispersal of all fresh-water forms has been normally by means of the changes in river systems, the fauna following up the river as the head waters of the latter work their way into new territory. Frequently, ancient changes in streams, incident to piracy or beheading, etc., may be known long afterward by the peculiarities of the fauna inhabiting the present river system, indicating many times that the present system is made up of several ancient systems. A case in point is the Tennessee River system which has been shown by C. C. Adams,[5] from a study of the distribution of the molluscan genus *Io*, to be made up of several smaller systems once separated by divides. Ortmann's studies on the Unionidæ and the crayfishes also bring out the value of distributional areas by river systems. The peculiar physical changes in the Ohio River previous to and following the glacial period, will doubtless be reflected in the fauna, both recent and extinct, when detailed studies are made bearing on this subject.

The point which the writer wishes to bring out and emphasize is that while it is true that there are the three primary divisions as indicated by Simpson and so strongly advocated by Germain, there are also in addition many smaller divisions which form precise faunal areas just as true and natural as the three major areas. The true relation of the different fresh-water faunas can only be determined by dividing the continent into areas separated by natural water partings, as has been done by Dr. Dall and the writer. That too many divisions have been made by the writer in his Lymnæa monograph may be true and is to be expected in a first attempt, but the method is the only satisfactory one for the study of fluviatile animals, a statement in which I am sure all American students will agree. Studies from this standpoint, however, have not yet been made in sufficient number and detail to work out a comprehensive scheme of subdivision. It was with a view to stimulating such studies that the map in question was published.

Germain (page 397) criticizes the author for his statement (page 84) that "It is not believed by the writer that the supposed land connection with Europe via Greenland contributed to any extent in the formation of the present Lymnæid fauna," and states that it is dangerous to base a general conclusion on a particular case. The statement was not based on the Lymnæidæ alone, but on the whole Basommatophorous group, the exotic species of which, from the data at present known, seems to have reached America by way of Alaska rather than by the Greenland connection. The absence of such striking forms as *Lymnæa stagnalis, Galba palustris* and *Aplexa hypnorum* from the Greenland fauna and their presence in the Alaska fauna is tangible evidence, to say the least. It is of course possible that this condition is due to a lack of sufficient detailed field work in northeastern America, but until this has brought to light the missing data the deductions must remain as based on present information. The invasion from Siberia was evidently contemporaneous with that of the larger mammals which occurred in the late tertiaries. The northeastern land connection is thought to have been used by several mollusks (Margaritana and some helices) and it would be strange indeed if some fresh-water mollusks of other groups did not also take advantage of the land bridge. However, in this as in other things the deductions must be based on the available facts and not on theories. The discovery of the European land snail *Tachea hortensis* in Pleistocene deposits[6] goes a long way toward establishing the existence of a northeastern land connection in late Tertiary time.

The critical study of the fresh-water faunas of many states and the ecological work of several universities is providing a mass of data which will ultimately afford the material for a satisfactory division of North America into natural faunal areas. It is quite possible, however, that it will be difficult to establish a system that will include both fresh-water and ter-

[5] National Academy Sciences, Memoir XII., No. 2, 1915.

[6] C. W. Johnson, *Nautilus*, XX., p. 73, 1906.

restrial species, the methods of dispersal being different in the two classes of animals.

FRANK COLLINS BAKER
NEW YORK STATE COLLEGE OF FORESTRY,
SYRACUSE UNIVERSITY

"SAME"—EDUCATIONAL EXPERIMENT STATIONS

TO THE EDITOR OF SCIENCE: I have read with much interest the bill of Senator Newlands for the establishment of engineering experiment stations and heartily approve "same."

It is especially gratifying to note that bulletins giving results of investigations "shall be sent to persons, newspapers, institutions and libraries . . . as may request same" (Sec. 3, SCIENCE, p. 891).

In connection with "same" it is interesting to note that the use of the word "same" without "the" before it, which formerly was considered a sign of illiteracy, has now so far become customary that it may be allowed in a bill introduced in the Senate of the United States, and that both "same" and "as" may be used as relative pronouns.

The bill for the establishment of engineering experiment stations should be passed, after it has been improved by the Senate's grammatical censor. It is to be hoped that some day in the near future another bill will be introduced in the Senate for the establishment of one or more Educational Experiment Stations. The government, through its Agricultural Experiment Stations teaches the farmer how to raise crops; through its Bureau of Mines it teaches the mine owners how to mine coal and to avoid wastes of property and of life; should it not have Educational Experiment Stations to teach our schools and colleges how to avoid educational wastes?

WM. KENT

SCIENCE AND WAR

TO THE EDITOR OF SCIENCE: The Boston Sunday *Herald* prints a feature called "Herbert Kaufman's Weekly Page." It must be popular, though the writer has never heard it quoted—in contrast to this paper's apotheosis of American wit, the "Line o' type." The page is a collection of moral sentiments in a form to which no one can deny a frequent force and picturesqueness. Its dominant appeal is emotional. A few issues since it contained an appreciation of science running in part as follows:

> For half a century we have liberally endowed, supported and encouraged the scientists. Community funds paid for the institutions in which they were educated and underwrote their experiments.
>
> And all the while, we believed that these endeavors were promotions in the interest of civilization. . . .
>
> To-day we stand horror-stricken before the evidence of inhumanities only made possible through scientific advancement. . . .
>
> Chemistry, you stand indicted and shamed before the Bar of History! . . .
>
> You have prostituted your genius to fell and ogrish devices. . . .
>
> You have turned killer and run with the wolf-pack.
>
> But we will reckon with you in the end.

We can probably agree with Mr. Kaufman that science has increased the amount of suffering that war inflicts. No account need be taken here of the questions if this is due to science or human nature, and if the compensations are not sufficient; the second because it admits an endless argument, and the first, of none. The issue boils down to whether, if the encouragement of science on the broad lines of the past were abandoned, the horrors of war would be proportionately lessened.

This would be conceivably so if it were humanly possible to restrict scientific work to lines of no value for warfare. But success in war is as keenly desired as ever, and it is the part now of every prudent nation to equip itself in the best practicable manner for carrying it on. The writer has elsewhere remarked on the commonplace that victory is not to the side that can exert the strongest physical force with its own bodies but which can most intelligently direct the forces of nature. If the total amount of scientific work were thus restricted the human result would be to concentrate the work of science more and more upon warlike matters with a consequently increased social suggestion of war. A liberal encouragement of scientific progress serves to diffuse men's energies over other and more peaceful interests. To blame chemistry for the horrors of

war is a little like blaming astronomy for nocturnal crime. It is better to keep the bellicose applications of science as its incidental products rather than the chief ones they would become under those elements of human nature that must also be "reckoned with" in the end.

F. Lyman Wells

McLean Hospital,
Waverley, Mass.

QUOTATIONS

SCIENTIFIC APPOINTMENTS UNDER THE GOVERNMENT

A scientific journal must avoid the discussion of party politics, but it is legitimate to point out that the two leading parties have adopted platforms which, as far as their principles go, might almost be interchanged, and have nominated candidates who have much in common, both of them being lawyers, university professors and sons of clergymen. In view of these circumstances it is of interest to those concerned with science that Mr. Hughes in his first campaign speeches should select as one of his two leading issues the appointments by President Wilson to scientific offices under the government. This would not have been a vital political issue a few years ago, and it is certainly gratifying that it should now have become so, more especially as both parties and both candidates profess the same desirable principles and only dispute about the extent to which they have been maintained.

In opening his campaign at Detroit, Mr. Hughes charged the administration with having displaced the scientific heads of the census and of the coast and geodetic survey with men not having scientific qualifications. The word "displaced" is ambiguous and was perhaps intended to be so, and the reply of the secretary of commerce that both men had "voluntarily retired" is also, and it may be purposely, ambiguous. Men familiar with university affairs, like the two candidates for the presidency, know that professors sometimes have their resignations presented to them. It is allowable to say either that Dr. Wilson displaced Dr. Patten as president of Princeton University or that Dr. Patten resigned and was succeeded by Dr. Wilson. As a matter of fact, Dr. Durand's resignation as director of the census was forced, and Dr. Tittman, who was sixty-five years old and in indifferent health, resigned voluntarily from the Coast and Geodetic Survey.

The vulnerable point in the action of the administration is the appointment of their successors. Mr. William J. Harris, appointed director of the census, was chairman of the democratic state committee of Georgia and the appointment appears to have been for political reasons, as has unfortunately so often happened in the bureau of the census, where the extension of civil service rules has been least adequate. E. Lester Jones, when appointed superintendent of the coast and geodetic survey to succeed Dr. Tittman, was deputy commissioner of fisheries. His appointment to that office and his promotion to the head of the survey in the same department appear to have been personal rather than political. He has proved to be an efficient executive, but his appointment to both offices certainly violated the principle that these positions should be held by experts.

It can not, however, be denied that there are two sides to this question. Under modern conditions a distinguished man of science is likely to be a good executive, but the number of scientific men available for a position of this character is limited, and it is by no means certain that it is desirable to divert the skilled expert from his research work to an executive position. Another solution of the problem would be to make the heads of bureaus purely administrative officers, to be filled by men used to administrative work, but for the scientific policy of the bureau to be decided by a committee of its scientific experts and for the more eminent of these to receive salaries not smaller than that of the executive head.

Mr. Hughes has not pointed out, as an impartial judge might have done, that the two scientific appointments mentioned are the only ones in which the president is open to criticism, or that he is the first president who has officially asked the advice of scientific men on such points. At the meeting of the council of the American Association for the Advance-

ment of Science, held in Washington on April 22, 1913, shortly after President Wilson's installation, the following resolution, proposed by Mr. Cattell, was passed:

WHEREAS, It is eminently desirable that scientific men especially skilled in their departments be appointed as heads of the scientific bureaus of the government, therefore,

Resolved, That a committee of three be appointed to communicate to the President of the United States that it is the opinion of the council of the American Association for the Advancement of Science that a scientific man skilled in meteorology should be selected as the Chief of the Weather Bureau.

The committee waited on the president who requested the secretary of agriculture to consult with the committee of the association. The secretary of agriculture at that time stated that no appointment in the department of agriculture had been made or would be made for political reasons, or even be given to a man who sought the office. The committee of the American Association called the attention of the secretary to the fact that the National Academy of Sciences is by law the scientific adviser of the government, and the president, as far as we are aware for the first time since the law was enacted in 1863, asked the advice of the academy on an appointment. A committee of experts of the academy recommended three men skilled in meteorology and fitted for the office of chief of the Weather Bureau, and one of these was appointed by the president. In like manner the commissioner of fisheries was appointed from candidates proposed by the American Society of Naturalists and the American Zoological Society. In other cases President Wilson has asked and followed the advice of scientific bodies and scientific men, and his record in this respect is certainly better than that of any of his recent predecessors. We can only hope that he himself or Mr. Hughes, as the case may be, will still further improve this record in the course of the next four years.—*The Scientific Monthly*.

PRESIDENT WILSON'S SCIENTIFIC APPOINTMENTS

CANDIDATE HUGHES has publicly charged President Wilson with having made appointments to scientific departments of the government without consideration of the scientific fitness of the appointees and to the detriment of the public service. The charge is so unfair and untrue that it deserves to be repudiated by all who know the facts with regard to any of these appointments, as it has been denounced already by Secretary Redfield and Acting Secretary Sweet with respect to the superintendent of the Coast and Geodetic Survey.

The fact is that no president within recent years at least has taken so much pains to obtain the advice of scientific societies and of scientific men regarding appointments to scientific positions within the government; and none has more faithfully followed that advice, as is shown, for example, in his appointment of the present commissioner of fisheries, the chief of the Weather Bureau, the chief chemist of the Department of Agriculture, etc.

The contrast between President Wilson's attitude in this respect and that of some of his predecessors is very striking. In 1898 the American Society of Naturalists and the American Society of Zoologists appointed a committee to wait upon President McKinley and urge him to appoint as commissioner of fisheries some trained scientific man who should have a practical knowledge of the fish and fisheries of our coasts. President McKinley told the committee that he was not free to consider their recommendation since the place had already been promised to one who, as it turned out, was not scientifically trained and whose only known qualification was that he was a deserving Republican.

In 1913 the same societies passed a similar resolution and sent a similar committee to President-elect Wilson upon the same subject. Mr. Wilson thanked the committee for bringing the matter to his attention and asked for recommendations of persons for the position. The committee considered the matter carefully and after consulting with various members of the societies and with others interested in our fisheries recommended three persons in order of preference and, although it is known that much pressure was brought to bear upon Pres-

ident Wilson to continue the custom of his immediate predecessors of appointing the commissioner of fisheries for partisan rather than for public services, he appointed the man who stood first in the committee's recommendations.

Again, in appointing the chief of the Weather Bureau, President Wilson took unusual means to secure the best available man by requesting the National Academy of Sciences to recommend a suitable person for the position. Although the Academy was established by Act of Congress in 1863 to serve as adviser to the government in matters of science, and although since that time it has had among its members the most distinguished scientific men in America, this was the first time that a president of the United States ever asked the Academy for advice as to a scientific appointment. Also, in the selection of the chief chemist of the Department of Agriculture and of the chief of the Bureau of Mines, the president sought and acted upon the best scientific advice which he could get. In no one of these cases did he inquire about the political affiliation of the person recommended.

In many other matters President Wilson has shown an unusual and unprecedented desire to consult the leading scientific bodies of this country on subjects of science and a marked degree of independence in following their advice, sometimes in spite of much political or personal opposition. Through his individual action the question of the best means of abating the slides at Panama was referred to the National Academy of Sciences, and at his request a committee was appointed to investigate and report upon this subject; the names of the committee were a sufficient guarantee that their work would be well done, and their report, which was promptly made, will probably be of inestimable value to the nation. Quite recently the President requested the National Academy of Sciences to take the initiative in bringing into cooperation existing governmental, educational, industrial and other research organizations with the object of promoting national welfare and of providing for national defense. As a result there has been established through the cooperation of national scientific societies, research institutes, universities and the scientific departments of the government a National Research Council, as described by Dr. George E. Hale in a letter to *The Times* on August 1, which should be of great and lasting value to this nation.

Under these circumstances it does not seem fitting that scientific men should allow to go unchallenged the statement that the scientific work of the government has been degraded by President Wilson's appointments or the implication that his interest in that work has been that of a partisan.—***Edwin G. Conklin of Princeton University in the New York Times.***

SCIENTIFIC BOOKS

Analytical Mechanics. By H. M. Dadourian, M.A., Ph.D. Second edition, revised and enlarged.

In his second edition of his "Analytical Mechanics," Dr. Dadourian has made a number of changes and additions. What he assumes as the fundamental principle of mechanics he now calls the "Action Principle" which is a modified form of what he formerly called "The Principle of Action and Reaction." "A new chapter has been added which is devoted to the equilibrium of framed structures and graphic statics." "The number of diagrams has been increased by one hundred and thirty, and about three hundred practical problems have been added." Other smaller changes have been made. In all the book has been enlarged by about seventy additional pages.

In his first edition, the author states that the book "is based upon a course of lectures and recitations which the author has given during the last few years to the junior class of the electrical department of the Sheffield Scientific School." "In order to make the book suitable for the purposes of more than one class of students a larger number of special topics are discussed than any one class will probably take up. But these are so arranged as to permit the omission of one or more without breaking the logical continuity

of the subject." "The historical order of the development of mechanics is followed by discussing equilibrium before motion."

The author certainly has given considerable thought to the preparation of his book, which contains some very interesting matter. In the large collection of problems he gives, there will be found some very interesting ones. The reviewer himself was sufficiently interested to think out solutions for a number of them.

The plan of the book is certainly unique in a number of ways. This is not necessarily a criticism. There is a wide feeling that text-books in mechanics written for our engineering students fail to interest the students as they ought to do, and it may be that that book that will be found most satisfactory will be written according to a plan that will be quite unique when compared with the plans in accordance with which our present standard text-books on mechanics are written. The reviewer of this particular text-book is unable to appreciate, however, the author's point of view of some parts of his book.

In the first place, the author devotes his first chapter (of 11 pages) to "Addition and Resolution of Vectors." After that he merely states that a quantity has magnitude and direction and that, therefore, it is a vector. In the composition and resolution of such quantities, he then uses the law of addition and resolution of vectors as developed in his first chapter. This makes everything easy, at least as far as the author is concerned. For instance, the composition of couples reduces itself to this: "The resultant of two couples is a third couple whose torque is the vector sum of the torques of the given couples." That is all that need be said concerning the composition of couples. Similarly for the composition of the other directed quantities.

The reviewer does not wish to criticize this mode of procedure but wishes to ask if this mode of procedure is legitimate. Vector addition is simply one of the operations in an algebra in which the parallelogram law is made one of the fundamental assumptions. Before we apply the law of vector addition to any kind of quantity, ought we not first assure ourselves that the parallelogram law holds for these quantities? Since force, for instance, is a directed quantity, does it follow that the parallelogram law holds for forces? The same may be said of other directed quantities. Vector representation of directed quantities is very important and useful, and vector addition and resolution should be given, but it should be given only after we are assured that the parallelogram law holds with reference to such quantities. If the author is correct in reversing this process, then certainly the theory underlying the composition and resolution of directed quantities becomes very simple.

In the second place, the author's plan is unique in that he takes the following principle as the foundation of his book: "The vector sum of all the external actions to which a system of particles or any part of it is subject at any instant vanishes." This principle he calls the "action principle." To understand what the author means by this principle, we must understand what he means by "action."

On page 15, the author states that "all actions to which a particle is capable of being subject may be divided in two classes, namely, *forces* and *kinetic reactions*." He then defines force as the action of one particle upon another. On page 17, he states that kinetic reaction represents the action of the ether on a particle and that it equals the product of the mass of the particle by its acceleration. That is, if q is this kinetic reaction then $q = -ma$. The negative sign is used since the direction of the action of the ether on a particle is opposite to the direction the particle is accelerating. If now F is the vector sum of the forces acting on one particle then the above action principle may be stated as follows (page 17):

$$\Sigma(F + q) = 0.$$

The reviewer is not sure that he understands what the author means by kinetic reaction. On page 17 and also on page 150, he states that kinetic reaction is the action of the ether on a particle. And on page 150 he adds that "kinetic reactions are not aggressive. In this respect they are similar to resisting and fric-

tional forces, but the latter come into action with velocity, while the former come into play with acceleration." On page 152 he states that "both forces and kinetic reaction must be the same type of magnitude."

These statements, together with others, seem to indicate that the author considers kinetic reaction as something real and of the nature of a force. In fact it is a force, although the author on page 150 states that kinetic reaction can not be called a force because we have restricted the latter term to the action of one material body upon another. Call it what we will, to the reviewer it seems to be nothing more nor less than a backward pull of the ether on a body as the body moves through the ether with accelerated motion. In fact, the author seems to say that the inertia of a body is due to the force with which the ether is pulling back on a body when the body is being accelerated.

Assuming that the author's conception of kinetic reaction is here correctly given, the reviewer is inclined to believe that several questions will at once present themselves to the readers of his book.

Why is it that the ether acts on a body only when it is being accelerated and not when the body is moving with constant velocity?

If kinetic reaction is the action of the ether on a particle, and if it is the same kind of a quantity as force (is a force in fact), and if the resultant force F acting on a particle and the kinetic reaction q are always equal in magnitude but opposite in direction (both equal to ma in magnitude), why is the body not in equilibrium? The author recognizes this difficulty in a footnote (page 153) by stating in effect that we must not call kinetic reaction a force, for if we do then the vector sum of all the forces acting on a particle will always equal zero without this particle necessarily being in equilibrium, a state of affairs which is not consistent with the condition of equilibrium of a particle. Refusing to call kinetic reaction a force, however, in order to keep out of trouble simply dodges the question and does not answer it.

The reviewer does not wish to say that the author is wrong in his conception. All he wishes to say is that he entirely fails to appreciate the author's point of view.

There is considerable difference between the author's action principle and D'Alembert's principle. Let there be a number of forces acting on a particle, then the resultant force (an ideal force) equals ma, or $R = ma$. This ideal force may be called the effective force. D'Alembert's principle then says that a system of forces acting on a particle together with the reversed effective force will form a system of forces in equilibrium. It should be remembered that this reversed effective force is an ideal force and not a real force. Now in the author's action principle the kinetic reaction is a real force (or action as the author prefers to call it) and is due to the action of the ether on a particle.

The author's action principle (even if sound) involves a number of conceptions which must be understood in order to understand the principle itself, and it seems that such a principle ought to follow rather than precede an elementary treatment of mechanics.

E. W. Rettger

Ithaca, N. Y.

SPECIAL ARTICLES

EXPERIMENTAL ABLATION OF THE HYPOPHYSIS IN THE FROG EMBRYO

In the following preliminary paper the effect of the extirpation of the epithelial portion of the hypophysis upon the subsequent growth and development of tadpoles is summarized. The work was first attempted in 1914, *Diemyctylus torosus* being used, repeated in 1915 upon *Rana pipiens*, and again repeated in 1916 upon *Rana boylei*. In this paper the results obtained with *R. boylei* are reported.

The operation was most successfully carried out upon approximately 3 mm. larvæ, at which time the tail-bud is forming and the stomadeum can be detected. At that stage the epithelial hypophysial invagination can be accurately determined from the pit that it forms, or from its location between the protuberance of the forebrain and the stomadeum, and can be removed without injury to the adjacent brain.

This epithelial ingrowth was removed with some neighboring epithelium. The wound healed within three hours, less than 1 per cent. of the larvæ disintegrating after the operation. About 200 larvæ of the 3 mm. stage were operated upon, the hypophysis being successfully removed in over 60 per cent. of the cases. Approximately 30 per cent. of those animals in which the gland was extirpated did not give reliable results in the rate of growth as the mouth was wholly or partially removed thus interfering with feeding. For checks, unoperated specimens and those in which the ablation of the gland was unsuccessfully attempted were available. The operated animals and checks were kept in boiled water for five days and then transferred to a frog tank where they were in an essentially normal environment.

The hypophysis-free animals grew more slowly than the normal controls. No hypophysectomized animals reached the size of the largest checks and the averages of the two show a noticeable difference. On June 6 the operated but not hypophysectomized animals had an average length of 40–43 mm., the hypophysis-free animals averaging 33–35 mm. A ratio such as this prevailed throughout their growth. The ratio of body to tail length is the same in the two classes, the difference in size being uniform for all parts of the animal.

Differences in color began to be noticeable at an early stage. From then on the contrast in pigmentation between the hypophysectomized animals and the checks was striking. Those animals without a hypophysis had a slightly darkened silvery appearance of an almost uniform character; however, the dorsal side was more pigmented than the ventral. These are referred to as albinos. The checks were a brown-black color often showing a mottling. This color difference was more noticeable over the body than on the tail, but was evident in both regions and was the most striking feature up to the time when the hind legs began to appear in the checks. Sections show that in the albinos the epidermis is pigment-free while that of the checks is filled with it. The subcutaneous pigment is present in the albino in as great a quantity if not greater than in the normal animal. The retinal pigment appears to be the same in both.

The hind leg buds appear, normally, when the tadpole has reached a length of 25–27 mm. In the albino the hind limb buds appear but slightly later than in the checks or when they are from 26–28 mm. in length. From this stage on, however, the hind limbs in the hypophysectomized animals grow but little if at all, although their total length increases at a rate but slightly under the normal one. For instance in 28 mm. checks the hind legs average 1.0 mm.; in 30 mm. checks 2.0 mm.; in 38 mm. checks 4.0 mm. In the albinos of each of the above sizes and ages the hind legs were 0.1 mm. long. The above is in accord with Adler ('14),[1] who found that the removal of the hypophysis in a 20 mm. stage inhibited the growth of the hind legs.

Sections of the albino and normal animals show striking contrasts in the organs. Of the specimens yet sectioned none described above as albino or hypophysectomized have had a trace of the anterior lobe of the hypophysis present. Thus it is certain that the entoderm has not the intrinsic power to form a hypophysis, but that if it enters into the formation of the gland at all it must be considered as a tissue inclusion which may become changed through its adaptability into glandular parenchyma, a conclusion previously drawn by the writer Smith ('14).[2] Comparison with the checks shows that the infundibulum undergoes structural modifications, although the saccus vasculosus, as far as determined, appears to be normal. In the checks that region of the diencephalon which rests against the pars glandularis is of considerable thickness, having in addition to the ependyma a rudimentary pars nervosa. Caudad to this the wall is formed almost entirely of ependyma. In the hypophysectomized animals the pars nervosa

[1] Adler, L., "Metamorphosestudien an Betrachierlarven. I. Extirpation endokriner Drüsen. *A*. Extirpation der Hypophyse," *Arch. f. Entwickelungsmech. d. Organ.*, Bd. 39, 1914.

[2] Smith, P. E., "The Development of the Hypophysis of *Amia calva*," *Anat. Rec.*, Vol. 8, 1914.

is reduced throughout most of its extent to an ependymal layer. Small localized thickenings may occur but nothing corresponding to the normal animal.

The difference in size and structure between the thyroid of an albino and that of a check is very marked. The thyroid of a normal 38 mm. tadpole with 4.0 mm. hind legs is approximately three times the size of a 37 mm. albino with 0.1 mm. hind legs. The compactness and character of the parenchyma show an even more striking contrast. A sagittal section through the thyroid of a 38 mm. check shows on an average 15–18 vesicles, many of which are largely distended with colloid, the parenchyma of the whole gland being compacted together, as compared with that through the thyroid of a hypophysectomized 37 mm. specimen which shows 4–5 atrophied vesicles containing but a slight amount, or no colloid, and with large spaces between the vesicles. The cells making up the vesicles of the former are cuboidal and protoplasmic-rich, in the latter little but nuclei remain. The results obtained from the experimental feeding of thyroid by Gudernatsch and others makes it highly probable that the non-development of the hind legs in the albinos is due immediately to the atrophy of the thyroid and not to the direct action of the hypophysis, a suggestion which Adler's work upon the tadpole also supports.

An examination of the gonads shows significant size differences between the normal and albino specimens. In the hypophysectomized animal the development of the sex glands is apparently much retarded and the size correspondingly reduced.

The author in a later and more complete account will describe any changes which may be found in the other endocrine glands and treat of the progressiveness of the changes noted.

P. E. Smith

Anatomical Laboratory,
University of California

Effect of Grinding Soil on the Number of Microorganisms

In connection with a study of the bacterial content of soil, it was found that pulverizing soil in a ball mill seriously affected the number of bacteria. This treatment not only reduced greatly the bacteria, but also that of many other microorganisms. In many cases the soil was partially air dry and contained clumps which were not easily broken by shaking in a water suspension. Because of the mass of soil particles, it was thought that perhaps grinding would result in a higher count. From the results below, it will be seen that such was not the case. Instead of a gain, there was a loss in number of organisms which was more marked the longer the soil was ground.

The test was made as follows: Fresh or partially air-dried soil, containing not more than 10 per cent. moisture, was placed in a ball mill partly filled with large pebbles. The mill was geared so that the porcelain jar revolved at the rate of 70 revolutions per minute.

TABLE I

A COMPARISON OF THE NUMBER OF BACTERIA IN GROUND AND UNGROUND SOIL

Test No.	Date	Soil	Bacteria in One Gram of Dry Soil		
			Unground	Ground	Time of Grinding, Hours
1	April 4	Miami silt loam	4,225,000	3,439,000	1
2	April 5	Red clay	626,000	570,000	1
3	April 6	Fine sand	216,000	198,000	1
4	April 11	Black silt clay loam	3,300,000	2,200,000	1
5	April 12	Colby silt loam	1,200,000	1,800,000	1
6	April 13	Carrington silt loam	2,000,000	400,000	1
7	April 14	Sandy loam	1,200,000	300,000	1
8	April 18	Medium sand	362,000	186,000	1
9	April 19	Plainfield loam	264,000	174,000	1
10	April 20	Muck	2,064,000	1,746,000	1
11	April 26	Miami silt loam	44,602,000	10,540	8
12	May 3	Garden soil	3,194,000	5,610	8
13	May 4	Garden soil	3,194,000	75	24

The following results, shown in Table I., illustrate the difference in the number of bacteria in the ground and the unground soil, as well as the effect of time of grinding on the number of bacteria. Grinding greatly reduced the number of bacteria except in one case, No.

5 Colby silt loam. Apparently the greatest injury caused by grinding for one hour is noted in the case of sandy soils.

When the soils were ground for 8 or 24 hours, there was an enormous decrease in the bacterial flora. This is readily noted from the figures of the last three soils given in Table I. After 24 hours of grinding the soil was rendered almost free of bacteria.

It is of interest in this connection to note the effect of long grinding on other soil organisms, *e. g.*, soil protozoa. Dilution counts on various culture solutions adapted to protozoa showed that the unground soils contained protozoa in dilutions greater than 1 to 10,000, while in many cases the ground soil failed to show any growth of protozoa. The garden soil, No. 12, contained protozoa in the first dilution, one gram in 10 c.c. of the medium. When ground for 24 hours this same soil did not show the presence of protozoa.

From the results, it seems fair to conclude that grinding soil in a ball mill injures the soil microorganisms. If this process is continued for several hours, the soil will be partially sterilized. Although no definite study has been made, it is most probable that the larger forms of plant life as fungi, yeasts and algæ suffer the same fate as the protozoa and bacteria.

E. B. FRED

UNIVERSITY OF WISCONSIN

AN ACOUSTIC DEMONSTRATION BEARING ON THE PULSE THEORY OF RADIATION

SOME years ago I made the acquaintance of the "pulse theory" of radiation. As I understood it then, the periodicity of any monochromatic light as observed by means of a spectral system was a function of the instrument of dispersion. If so, how various sources could give different spectra when their radiation was dispersed by the identical instrument was to me an unanswered question. It was unthinkable that there should not be some characteristic difference between the pulses, or their manner of succession, in the two cases.

The demonstration which I am about to describe developed as the result of a more recent informal discussion of the subject in this laboratory. It occurred to me that the acoustic analogy of such a theory should have as its consequence this fact: that an irregular series of impacts would cause wave disturbances in the air such that a resonator of any period, within certain limits, should respond.

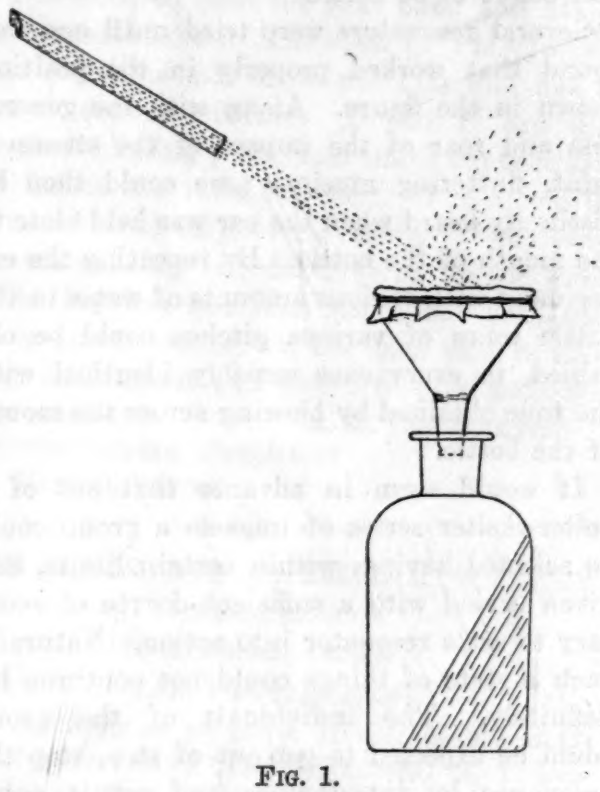

FIG. 1.

Such a series of impacts was furnished by a stream of sand-particles falling against an inclined paper surface, and the resonator was the classic glass bottle, which was made to respond to different periods by introducing different amounts of water.

Essentially the experimental set-up (which was about twenty minutes in construction) consists of a vertical glass tube of 7 mm. bore, constricted to about 4 mm. at a point near its top and some 42 cm. from its lower end; of a funnel, whose expanded end is covered with a rather loose diaphragm of thin tracing paper; and the resonator described. The sand was allowed to flow through the constriction in the tube, and the stream subsequent to this was kept from spreading too much by the portion of the tube below, falling freely a distance of 12 cm. from the lower extremity of the latter before striking the diaphragm (Fig. 1). The sand was what is known to the drug trade as

"fine silver sand," from which the smaller particles, to the extent of about one third of the mass, had been sifted out for another purpose. There is to my knowledge nothing critical about these specifications. They are simply the result of guess and circumstance, with the result about to be stated.

Several resonators were tried until one was found that worked properly in the position shown in the figure. Along with the general hiss and roar of the impact of the stream a faint, fluttering musical tone could then be distinctly heard when the ear was held close to the mouth of the bottle. By repeating the experiment with various amounts of water in the bottle tones of various pitches could be obtained, in every case sensibly identical with the tone obtained by blowing across the mouth of the bottle.

It would seem in advance that out of a helter-skelter series of impacts a group could be selected having, within certain limits, any given period with a sufficient degree of accuracy to set a resonator into action. Naturally such a state of things could not continue indefinitely. The individuals of the group could be expected to get out of step, stop the resonance by interference and set it going again in another phase. Hence the fluttering quality of the note, due apparently to the separate wave-trains so set up.

If the regular periodicity is a function of the analyzer, how may two pulse-series as supposed in the case of black-body radiation at two different temperatures give rise to characteristically different spectra? The answer to this question seems to me now quite natural. If we consider the effect, in this experiment, of varying the size of the constriction which limits the outflow of sand, it seems probable that increasing the outflow, by increasing the average number of impacts per unit time, would cause the resonator to give relatively greater response (as to amplitude or energy) at higher frequencies and *vice versa*. Another condition bearing on the "spectral distribution" of energy in this case would seem to be the relative numerousness of the different-sized particles composing the sand; other conditions being equal, the smaller ones presumably tending on the whole to give rise to high, the larger to low frequencies. This is merely speculation, as the careful experimentation necessary to show such changes has not been carried out.

The experiment as described here is scarcely demonstrable to more than one person at a time. It has certainly yielded large educational returns, to me personally at least, considering the insignificant outlay of time and material. I am especially interested in knowing whether it is essentially new or whether it has been proposed or used before.

P. W. Cobb

Nela Research Laboratory,
National Lamp Works of
General Electric Company,
Nela Park, Cleveland, Ohio

A PRIMARY CIRCUIT KEY FOR QUANTITATIVE INDUCTION WORK

Physiological investigation requiring either the calibration of an inductorium or the use of such calibrated inductorium necessitates a

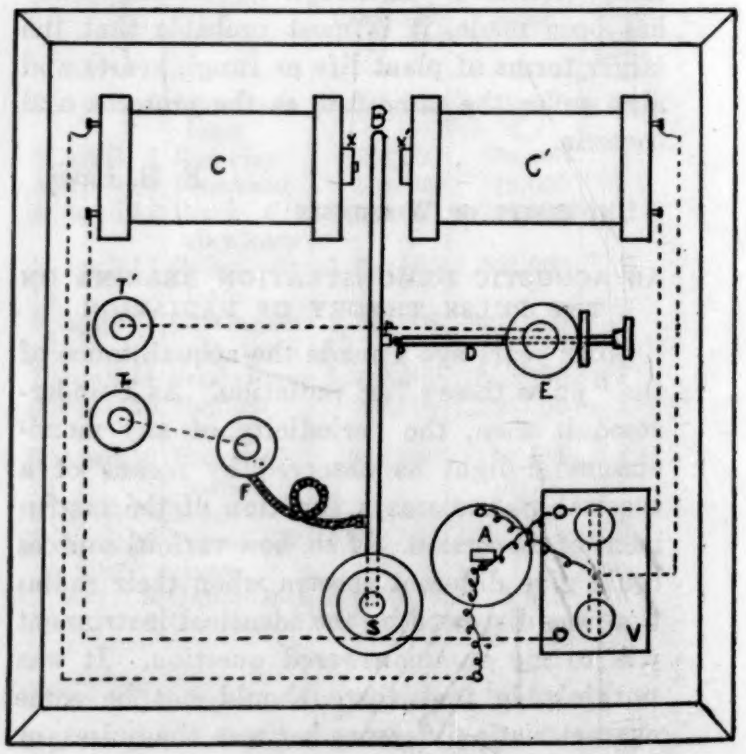

Fig. 1.

"make" and "break" key in the primary circuit which possesses certain qualities. Each

"make" and each "break" must occur with a constant velocity. The contact must be made and broken suddenly and firmly and there must be no vibration at the contact points.

Martin's key[1] has proved to answer these qualities but is not so compact as the key here described. Erlanger's key[2] designed to be used as a "knock over" key is not suitable for use except with a pendulum.

Such a large number of keys have been described that one hesitates to add another. It seems, however, that the simplicity of this principle and the ease with which this key may be used merits description.

In this key the well-known principle of induced magnetism is employed. The current for the coils (C and C') is obtained from a dry cell battery (A) so connected through an ordinary push-botton key (V) that when one button is down the current passes through one coil (C); when the other button is down the current passes through the other coil (C'). The coils contain soft iron cores (x and x'). One iron core (x) has a brass pin projecting from its center which prevents the steel band

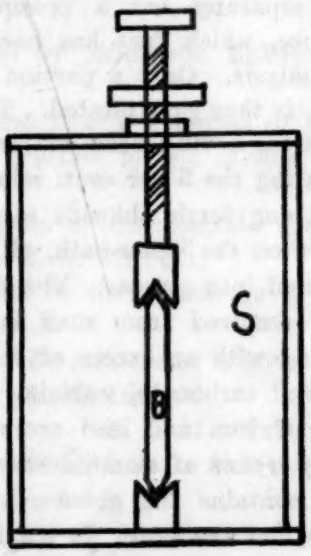

FIG. 2.

(B) from touching the core, thus eliminating any possibility of a "dead center" in the swing of the steel band. The contact points prevent the steel band from touching the other core. The steel band swings in an adjustable brass socket (S), the details of which are shown in Fig. 2. From the steel band a light spring wire (W) leads to a post (F) thus permitting free swing. For contact points, platinum iridium is used (P and P'). The one (P) is soldered onto the steel band and has a flat contact surface. The other (P') is soldered onto an adjustable brass pin (D) and has a convex contact surface. T and T' are the terminal binding posts from which connections are led to the induction coil. The whole is mounted on black fiber 3/8" thick, the connecting wires being imbedded on the under side.

The key has not been tested out with the string galvanometer, but has been used in making calibrations and found to give satisfactory results.

R. E. LEE GUNNING
NORTHWESTERN UNIVERSITY
MEDICAL SCHOOL

[1] Martin, *Am. Jour. Phys.*, XXIX., 1910, 181.

[2] Erlanger and Gerrey, *Am. Jour. Phys.*, XXXV., 1914, 384.

THE AMERICAN CHEMICAL SOCIETY

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The Synthesis of p-Cymene Monocarboxylic Acids and of certain of their Derivatives: M. T. BOGERT AND J. R. TUTTLE.

The authors have prepared the two possible ring isomers, cymene 2-carboxylic acid and cymene 3-carboxylic acid, from the corresponding bromo derivatives by the Barbier-Grignard reaction, using CO_2 under pressure, and have studied these acids and the following derivatives thereof: Na, K, Ba, Ca, Cu and Ag salts, methyl and ethyl esters, acid chlorides, amides, anilides, hippuric ester and acid compounds, hydrazides, furo- and thio-diazoles. Small amounts of the 2-acid have been obtained heretofore by other investigators and a few salts have been recorded, but we believe that this is the first time that the acid has been prepared in sufficient amount for more extended study. The isomeric 3-acid appears to be entirely new.

Benzoylene Urea and Some of its Nitro Derivatives: M. T. BOGERT AND G. SCATCHARD.

The preparation of benzoylene urea from anthranilic acid, through o-ureidobenzoic acid, has been improved. The nitro derivatives were prepared either from the corresponding nitro anthranilic acids or by direct nitration of benzoylene urea itself. These nitro benzoylene ureas are struc-

turally related to the nitro phenols, and certain of them have been found to be very sensitive indicators for the determination of hydrogen ion concentrations.

A New Group of Azo Dyestuffs: M. T. Bogert.

It has been shown by various investigators, including the author, that azo dyestuffs may be prepared from quinazolines carrying a primary Bz-amino group, by diazotizing this amino group and coupling the resulting diazo bodies with any of the well-known couplers. It has now been found that quinazolines themselves may function as couplers and, by combination with various diazotized or tetrazotized bases, a new series of azo dyestuffs has been obtained.

Methylene Disalicylic Acid and Derivatives: Robert A. Hall.

The Addition Compounds of Phenols with Organic Acids: James Kendall.

Derivatives of l-Isocamphoric Acid—An Unusual Formation of a Methyl Ether of a Hydroxy Acid: William A. Noyes and Glenn S. Skinner.

The method employed in the preparation of l-isocamphoric acid was that outlined by Noyes and Knight.[6] The methyl ester of isoaminocamphononic acid was prepared according to the procedure of Noyes and Littleton[7] with slight modifications.

The above ester was decomposed with nitrous acid and the following compounds have been found: (1) The methyl esters of two unsaturated acids, (2) the methyl ester of a hydroxy acid, and (3) the methyl ether of a hydroxy acid. Difficulties were encountered in the purification of the products. However, it has been shown without much doubt that one of the unsaturated acids is lauronolic acid. The physical constants of the hydroxy acid obtained by saponifying the ester correspond in the main to those of cis-camphonolic acid. The keto acid obtained by oxidation of this acid with chromic acid shows a like resemblance to camphononic acid.

The formation of the ether acid under the conditions of the experiment is, so far as we are aware, unparalleled. Its identity has been established by analysis and by the determination of the methoxy group according to the method of Zeisel. Its configuration has not been determined. The study of these compounds is being continued.

Researches on Pyrimidine-Nucleotides. New Developments: Treat B. Johnson.

[6] *J. Am. Ch. Soc.*, 32, 1669.
[7] *Ibid.*, 35, 75.

The Action of Ferric Chloride and other Ferric Compounds upon Cellulose: Louis Kahlenberg.

It has long been known that ordinary solutions of ferric chloride and other ferric salts have some solvent action upon cellulose. That action has hitherto been found to be but slight. However, a very concentrated solution of ferric chloride, such as is obtained by melting the usual commercial hexahydrate, dissolves cellulose with great ease. In fact, it is the best solvent for cellulose thus far discovered. The action begins at the melting point of the hydrate and proceeds very well at 50° centigrade. On heating to somewhat higher temperatures the action is very greatly accelerated. At the temperature of the water-bath it is a simple matter to dissolve 5 per cent. of cellulose in the concentrated solution resulting from the melting of the hexahydrate. More cellulose will be taken up until the whole mass becomes an exceedingly stiff syrup. On allowing the material to solidify it may be pulverized, and it will be found that it has to a very large extent lost its hygroscopic properties, which would indicate that a combination between the ferric salt and the cellulose has taken place. Attempts to isolate such a combination have been made and are still in progress.

When the solution of the cellulose in the concentrated ferric chloride solution is poured into water there separates out a precipitate of hydrated cellulose, which fact has been determined by careful analysis. Only a portion of the cellulose, however, is thus precipitated. The remainder stays in solution, having been converted into glucose. By heating the 5 per cent. solution of cellulose in the strong ferric chloride solution for two to three hours on the water-bath, all of the cellulose is converted into glucose. The ferric chloride may best be removed from such solution by diluting, treating with an excess of freshly precipitated basic lead carbonate, warming and filtering. Final traces of iron and lead are removed from the filtrate by means of ammonium sulphide. The filtrate then contains the glucose and some ammonium salts, but the latter do not interfere seriously with the characterization of the glucose by means of the test with phenyl hydrazine. Excellent crystals of glucosazone of characteristic melting point may be thus obtained from the solution.

Very concentrated ferric bromide and ferric sulphate solutions act similarly, but they are by no means equal to the ferric chloride in their solvent action. Not only may simple cellulose, like cotton and filter paper, be dissolved in the very

concentrated ferric chloride solution, but also compound celluloses, like woody fibers of all kinds, are thus disintegrated.

The entire subject is being pursued further, particularly as applied to the study of the compound celluloses and the various products that are associated with them in the various woods and woody fibers of different plants.

Similarly, concentrated solutions of the chlorides of other metals, like those of copper, cobalt, nickel, aluminum, calcium, magnesium, etc., have also been tested as to their solvent action upon cellulose. While these have some action upon cellulose, the action is quite slight as compared with that of ferric chloride. The action of ferric chloride upon cellulose, therefore, is a highly specific and unique one.

This entire subject is being studied further, especially as to its possible practical applications in isolating and utilizing various plant products.

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. E. Howe, *Chairman*

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The Determination of Ash in Coals with a High Percentage of Calcium Carbonate: S. W. PARR.

The Mechanical Sampling of Illinois Coal: S. W. PARR.

A New Form of Adiabatic Calorimeter: S. W. PARR.

Report on Last Year's Progress of the Industrial Fellowship System of the Mellon Institute: R. F. BACON.

An Investigation of Composition Flooring: R. F. BACON AND R. R. SHIVELY.

A Contribution to the Chemistry of Laundering: H. G. ELLEDGE.

On the Use of Certain Yeast Nutriments in Bread Making: H. A. KOHMAN.

On Hydrated Lime: J. F. MACKEY.

On the Prevention of Glass Pot Corrosion: S. R. SCHOLES.

On the Behavior of Manganese in Glass: S. R. SCHOLES AND E. W. TILLOTSON.

Further Experiments on Volatilization of Platinum: G. K. BURGESS AND R. G. WALTENBERG.

This paper is a continuation of previous work on the loss in weight on heating of platinum laboratory ware. It is shown that all grades of platinum contain at least traces of iron, that there is no appreciable loss in weight of crucibles heated to 900° C., but that above this temperature the loss increases rapidly with temperature, is greatest for platinum containing iridium and least for platinum alloyed with rhodium.

The Isomeric Lactones, Caryophyllin and Urson: FRANCIS D. DODGE.

Caryophyllin $(C_{10}H_{16}O)_n$, constituent of clove buds, was thought to be an alcohol, $C_{40}H_{60}(OH)_4$, but the present work indicates that it is more probably an oxy-lactone, $C_{20}H_{48}O_3$. Salts, two mono-acetyl and a diacetyl derivatives have been prepared. Oxidation with nitric acid gives caryophyllic acid, $C_{20}H_{48}O_9$; and acetylation of this acid gave an acetyl derivative, m. 210°, probably from an oxy-di-lactone derived from caryophyllic acid by the loss of one molecule of CO_2 and of H_2O.

Urson, a constituent of bear-berry leaves (*Uva Ursi*), $C_{30}H_{48}O_3$, is probably an isomer of caryophyllin.

Both lactones give the color-reaction of Liebermann for the cholesterol series.

Tautomeric Equilibrium Constants and Chemical Structure. A Measure of Valence in Terms of Energy: C. G. DERICK.

Preparation and Characterization of Trimethylene Oxide: D. W. BISSEL AND C. G. DERICK.

Trimethylene oxide was successfully prepared by two methods. The first used was by the action of trimethylene chlorhydrine on fused potassium hydroxide at 140°, yield 6–8 per cent. The other method was by the action of the acetate of trimethylene chlorhydrine upon fused postassium hydroxide at 100–110°, yield 22 per cent. The oxide is purified by fractional distillation after removing unsaturated products by bromination. Its structure follows from the fact that it yields hexanol-1 with propyl magnesium bromide; and trimethylene chloride with phosphorus pentachloride. Trimethylene oxide is a colorless, mobile liquid; miscible with water and having a pleasing odor. B. P. 47.8° (corr.); $D_{4^\circ}^{25^\circ}$ 0.893; $(N)^{25^\circ}$ 1.389 by Abbé instrument with ordinary light.

The Action of Metallic Oxides on Trimethylene Halides and of Heat upon $ClCH_2CH_2CH_2$-O-Mg-I: E. H. VOLLWEILER AND C. G. DERICK.

Lead oxide acts on trimethylene bromide at 200°, giving a substance boiling at 50–60° which consists mainly of unsaturated compounds. The yield was poor. A polymer of trimethylene oxide, boiling at 180° under 50 mm., is obtained. Its structure follows from the fact that it gives hexanol-1 with propyl magnesium bromide.

Mercuric and silver oxide react similarly, yielding no appreciable quantities of monomolecular trimethylene oxide. Trimethylene iodide can not

be used as it decomposes and the chloride reacts too slowly.

Cl-$CH_2CH_2CH_2$-O-Mg-I prepared by the Grignard reaction decomposes at 270°, giving mainly trimethylene iodide and a small amount of product boiling at 70–100° which is partly ethyl iodide and partly some unidentified mixture of iodine compounds.

The Behavior of β-Phenoxy Ethyl Bromide in Wurtz-Fittig Synthesis: St. Elmo Brady.

The type of ether, C_6H_5-O-CH_2CH_2Br, was prepared from sodium phenolate and ethylene bromide and the reaction so regulated as to obtain a maximum yield of the bromethylphenyl ether instead of the diphenoxy ether which under certain conditions has an equal chance for formation with the bromethylphenyl ether. The regular Wurtz-Fittig synthesis was carried out with the single modification of varying the amount of sodium used. The products were ethylene gas, sodium phenylate, and α, δ-diphenoxybutane in 10 per cent., 20 per cent. and 30 per cent. yields respectively.

The interesting fact observed in this synthesis was the unvarying yield of α, δ-diphenoxybutane with increasing amounts of the reacting materials and an increase in the yield of ethylene gas under the same conditions. The yield of ethylene gas is directly proportional to the amount of sodium used.

Preparation and Characterization of ε-Acetylcaproic Acid: St. Elmo Brady and C. G. Derick.

Trimethylene bromide and acetoacetic ester were condensed, molecular proportions of the reacting substances being used. The resulting condensation product was hydrolyzed with 20 per cent. hydrochloric acid and the nonhydrolyzable matter separated. The aqueous portion is treated with solid sodium carbonate and the separating product removed and purified. This is γ-acetylbutyl alcohol. The alcohol is brominated and the bromide condensed with malonic ester. The 1, 1 dicarboxethyl heptanone-6, after purification, is hydrolyzed with 20 per cent. hydrochloric acid and the resulting dicarboxylic acid heated to 170°. By the loss of carbon dioxide the ε-acetylcaproic acid is formed. The acid is easily soluble in alcohol, ether and water and is somewhat hygroscopic. It melts at 28° and boils constant at 145° under 1 mm. pressure. The ionization constant is $1.638 .0005 \times 10^{-5}$.

Preparation and Characterization of δ-Acetylvalerianic Acid: R. W. Hess and C. G. Derick.

Trimethylene glycol was converted into the bromide by refluxing with aqueous HBr. By using the proper proportions the yield was increased from 50 per cent. to 80 per cent. γ-Brombutyronitrile was made from the trimethylene bromide and KCN. When a mixture of water and alcohol was used as a solvent the yield was 20–25 per cent., but with absolute methyl alcohol it was 40–50 per cent. The action of γ-brombutyronitrile on sodium acetoacetic ester gave two new products, the one desired, δ-cyano-α-acetylvaleric ethyl ester and another 1, 7, -dicyano-4-aceto-4-carboxethyl heptane. The latter boils at 200° under 5 mm. pressure; melts at 73.5° and is insoluble in most organic solvents. An excess of acetoacetic ester prevents the formation of this substance. The former distills at 154° under 2 mm. pressure and hydrolyzes to δ-acetylvalerianic acid with constant boiling HCl. B. p. 181° under 25 mm. pressure; m. p. 36.5°; ionization constant 1.93×10^{-5}.

A Study of the Isomeric Aminoethylbenzenes and Certain of their Derivatives: O. S. Keener, O. Kamm and C. G. Derick.

Syntheses in the Naphthalene Series: Oliver Kamm and H. B. McClugage.

A Study of the Equilibrium in the Friedel and Craft Reaction: Oliver Kamm and S. D. Kirkpatrick.

On the Reactions of the Formamidines. V. On some Pyrazolone Derivatives: F. B. Dains, H. R. O'Brien and C. L. Johnson.

Contributions to our Knowledge of Dichlorether. Part II.: G. B. Frankforter and S. J. Reichert.

The Action of Aluminum Chloride on the Alcohols and Carbohydrates Alone and in the Presence of Other Organic Compounds: G. B. Frankforter and V. Kokatnur.

A Catalytic Decomposition of Some Phenol Salts: W. H. Hunter.

Some Work on the Reimer-Tiemann Reaction: W. H. Hunter.

Notes on the Use of the Multiple Unit Electric Furnace and of a Modified Carbon Dioxide Generator in the Dumas Method for the Determination of Nitrogen: Harry L. Fisher.

The furnace has excellent temperature control with all ranges, the units are well insulated, and it has a nickel trough which is permanent and does not stick to melted glass. The combustion tube can be inspected at any time.

The generator is arranged for either pressure or vacuum work and can be constructed of varying capacity and in a compact form. It consists of two round-bottomed flasks, the upper being in-

verted and connected with the lower one with a T-tube, which allows equalization of pressure in both flasks, and a 3-way stopcock. By means of the latter sulfuric acid may be dropped upon sodium bicarbonate in water or the acid in the upper chamber replenished or removed.

The Relations in Composition of Petroleum, Coal and Natural Asphalts: C. F. MABERY.

I have distilled Palmyra, C., coal in vacuo to compare the products with the constituents of Mahone petroleum which is in the same section. The distillates were composed of an oil heavier than water which was composed to a considerable extent of color substances which appeared during purification of the hydrocarbons in various shades of red, green, blue and violet. From the lighter oil was separated a number of hydrocarbons of the series C_nH_{2n}, C_nH_{2n-2}, C_nH_{2n-4}, resembling the hydrocarbons separated from Mahone petroleum, three years ago. A considerable proportion of solid hydrocarbons were separated, including some of the higher paraffines. Acetic aldehyde appeared in the lower distillates as it has been recognized in Mahone petroleum. I have also distilled Gilsonite in vacuo and obtained 56 per cent. of a thin oil from which a series of hydrocarbons similar to those in petroleum. Three classes of products were separated; the last mentioned, that evolve HBr copiously with bromine, forming a substitution lighter than water, a second, closely resembling hydrocarbons of a different character, that I mentioned 25 years ago as separated from acid sludge, and then alluded to as resembling the terpenes, giving with bromine hydrobromic acid and a product heavier than water, and a third class, composed of nitrogen derivatives like those I described 15 years ago as from California petroleum and recently identified in other varieties, especially in larger amount from Russian (Baku) petroleum. These products are at present under examination.

The Occurrence of Esdragol in Rosin: CHARLES H. HERTY AND V. A. COULTER.

On the Phenolsulphonphthalein Dyes and the Quinonephenolate Theory of Indicators: E. C. WHITE, H. A. LUBS AND S. F. ACREE.

On the Use of Viscose as a Dialysis Membrane: H. A. LEWIS AND S. F. ACREE.

On the Tautomeric Reactions of the Silver and Mercury Salts of 1-Phenyl-4, 5-dihydro-5-oxy-3-triazolyl Methyl Sulphone with Alkyl Halides: E. H. WIGHT AND S. F. ACREE.

On the Reactions of Both the Ions and Molecules of Acids, Bases and Salts: The Inversion of Menthone by Sodium, Potassium and Lithium Ethylates: W. A. GRUSE AND S. F. ACREE.

The Galactan of Larix occidentalis: R. W. SCHORGER AND D. F. SMITH.

Further Evidence for the Electronic Formula of Benzene and the Substitution Rule: H. S. FRY.

Reactions in Non-aqueous Solvents: Chromyl Chloride and Phosphorus Halides: H. S. FRY AND J. L. DONNELLY.

Electronic Tautomerism: The Existence of Electrometers in Dynamic Equilibrium: H. S. FRY.

Partial Hydrogenation of Cotton-seed Oil: BEN H. NICOLET.

The Reaction between Alcohols and Hydrochloric and Hydrobromic Acids: JAMES F. NORRIS.

The Nitro Phenyl Ethers: HILTON IRA JONES AND ALFRED N. COOK.

The ortho and para nitro phenyl ethers have been studied and numerous errors corrected. Eighteen sulphonic acid salts have been prepared and seventy-two new phenyl ether dyes, several of which are of brilliant shade and have commercial possibilities. These are equally divided between the ortho and para ethers of the sulphonated and unsulphonated series. A new method has been devised for the preparation of potassium phenolate to all non-nitro phenols. The effects of the positions of the groups upon the properties of the compounds and colors of the dyes have been carefully studied and various interesting facts observed.

The Relations in Composition of Coal, Petroleum and the Natural Asphalts: C. F. MABERY.

In distilling Deerfield, O., coal in vacuo, and gilsonite, it is found that the distillates contain petroleum hydrocarbons of the series C_nH_{2n-2}, solid paraffines, the series C_nH_{2n-4}, and nitrogen compounds resembling those which have been separated from California, Russian and other petroleums. Intense colors appeared in some distillates. A series of terpenes appeared resembling those extracted by acid from petroleum. Naphthene acids were recognized. These products and also a new series of petroleum hydrocarbons, probably terpenes, separated twenty years ago in large quantity with the sulphur compounds, are under examination.

Esterification of Acids by Isomeric Mercaptans: J. W. KIMBALL AND E. EMMET REID.

It has long been known that alcohols of different structure show different velocities and limits of esterfication, these values being much lower for secondary than for primary alcohols. It has also

been shown that mercaptans are analogous to alcohols in esterfication. In the present work the rates and limits of esterification of benzoic acid by normal, iso-, and secondary butyl mercaptans have been measured at 200° and the same relations found to hold with the mercaptans as with the alcohols.

Esterification of Acids by Isomeric Mercaptans: J. H. Sachs and E. Emmet Reid.

Since with a given alcohol, isomeric acids show different esterification velocities, the present work was undertaken to find whether the same relations hold when isomeric acids are esterified by the analogous mercaptans. The three toluic acids have been heated with ethyl mercaptan at 200°. Esterification progresses most rapidly with the meta isomer and most slowly with the ortho. The limits are nearly the same, 14.4, 13.2 and 13.3 per cent. for ortho, meta and para, respectively.

Catalytic Preparation of Nitriles: G. D. Van Epps and E. Emmet Reid.

It is known that when the vapors of acetic acid and of alcohol are mixed and passed over certain metal oxides at high temperatures, water is split off and ethyl acetate is formed. It is now found that when the vapor of acetic acid and ammonia gas are passed over alumina at 500°, water is eliminated and acetonitrile is formed up to 85 per cent. of the theoretical.

$$CH_3COOH + NH_3 = CH_3CN + 2H_2O.$$

The Preparation of Nitriles: G. D. Van Epps and E. Emmet Reid.

Reid's method for the preparation of nitriles, which consisted in heating a mixture of the zinc salt of the organic acid and lead sulphocyanide, and which gave good results with aromatic acids, has been extended to aliphatic acids and good yields obtained. The preparation of acetonitrile was extensively studied, a large variety of modifications of the method being tried. Good yields have been obtained, but this method is rendered obsolete by the discovery of the catalytic method.

The Identification of Acids: E. Emmet Reid.

p-Nitrobenzyl bromide has been found to be an excellent reagent for the identification of acids. One gram of this reagent is boiled an hour with an excess of the alkali salt of the acid in 15 c.c. of 63 per cent. alcohol. *E. g.*, $O_2N \cdot C_6H_4 \cdot CH_2Br + CH_3COOK = KBr + CH_3COO \cdot CH_2 \cdot C_6H_4 \cdot NO_2$.

The p-nitrobenzyl esters so formed crystallize well as a rule, have good melting points, and convenient solubilities. With the alkali salts of phenols, under the same circumstances, the same reagent forms ethers which are convenient for the identification of phenols.

Some Anomalies in the Solidification Points of Fats: B. H. Nicolet and L. M. Liddle.

On the Nitration of Toluene: I. W. Humphrey.

The Hydrolysis of Chloropentanes as affected by High Pressures: Synthetic Fusel Oil: H. Essex and B. T. Brooks.

The Effect of Sulphur on the Auto-Oxidation of Organic Compounds: B. T. Brooks, I. W. Humphrey and B. Y. Long.

Two New Methods of Determining Acetylene in Gaseous Mixtures: G. O. Curme, Jr.

Note on Lead Propionates: S. Frank Cox.

Neutral lead propionate is formed almost quantitatively when lead carbonate is treated with hot, dilute propionic acid. It is an amorphous, white solid, very soluble in water, insoluble in ether. If the tetroxide be treated with dilute propionic acid, the black dioxide is thrown out on boiling the mixture, and neutral lead propionate is formed practically quantitatively. If litharge containing a considerable percentage of carbonate be used, neutral lead propionate, rather than either of the basic propionates which are reported, is formed. Analysis shows that lead carbonate will give the purest propionate, and the yields in this case are also the most satisfactory. Lead and hydrogen determinations, also the reaction with chlor di methyl ether whereby lead chloride is formed quantitatively, were used to identify the salts prepared.

Crystalline β-Methyl Fructoside and Its Tetracetates: C. S. Hudson and D. H. Brauns.

A Fourth Crystalline Pentacetate of Galactose and Some Related Compounds: C. S. Hudson and J. M. Johnson.

The Isomeric Pentacetates of Glucosamine and of Chondrosamine: C. S. Hudson and J. K. Dale.

Indirect Measurements of the Rotatory Powers of Some of the Alpha and Beta Forms of the Sugars by Means of Solubility Measurements: C. S. Hudson and E. Yanovsky.

Some Numerical Relations among the Rotatory Powers of the Compound Sugars: C. S. Hudson.

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Charles L. Parsons,
Secretary

(To be concluded)